Products Finishing

CLEANING
PLATING
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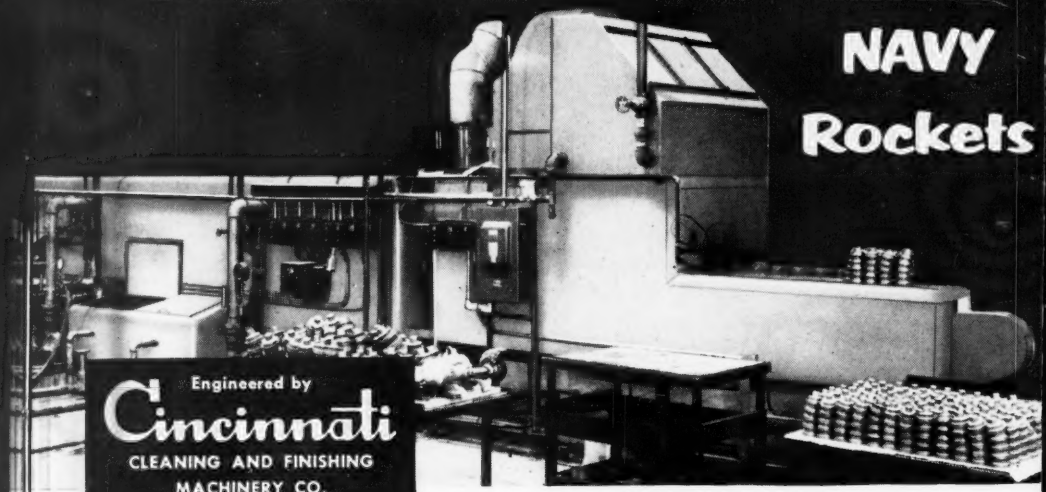
SEPTEMBER 1952

Complete Finishing System for NAVY Rockets



Engineered by

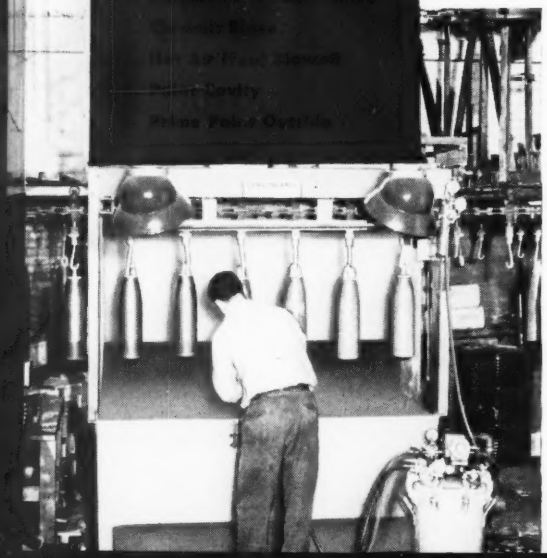
Cincinnati

CLEANING AND FINISHING MACHINERY CO.

at the U. S. Naval Industrial Reserve Ordnance Plant operated by United States Hoffman Machinery Corp., Poughkeepsie, N. Y.

Cleaning and Bonderizing Machine

Spray Booth; painting Rocket exterior



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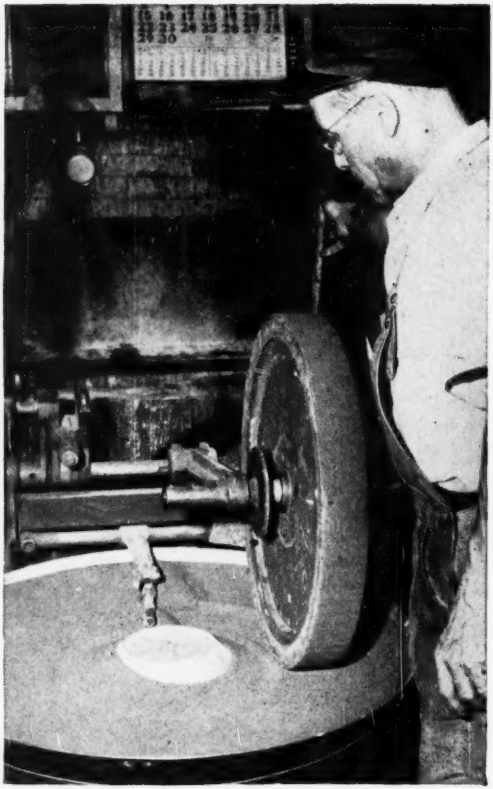
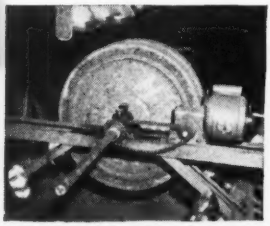
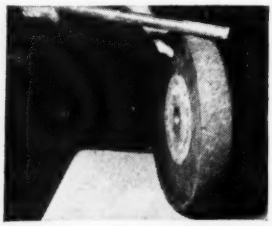


HOW TO SET UP a polishing wheel. Glued wheel, shown here, is automatically rolled in a trough of abrasive grain. To minimize jelling, the setting-up operation is carried out as quickly as possible.



HOW TO DRY a polishing wheel. Infrared lamps dry wheels faster and permit smaller inventory of wheels. Note mechanism for rotating wheels easily. Ideal dry room maintains temperature of 85° F. and 50% relative humidity. When wheel cracks readily, it is dry.



HOW TO CRACK the wheel head. Wheel face is hit at about a 45° angle, being struck completely around the wheel once or twice. It is then hit at an angle that forms an "X" with the first series of cracks. A round bar or pipe, *not a sharp tool*, is used.

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Products finishing

September 1952
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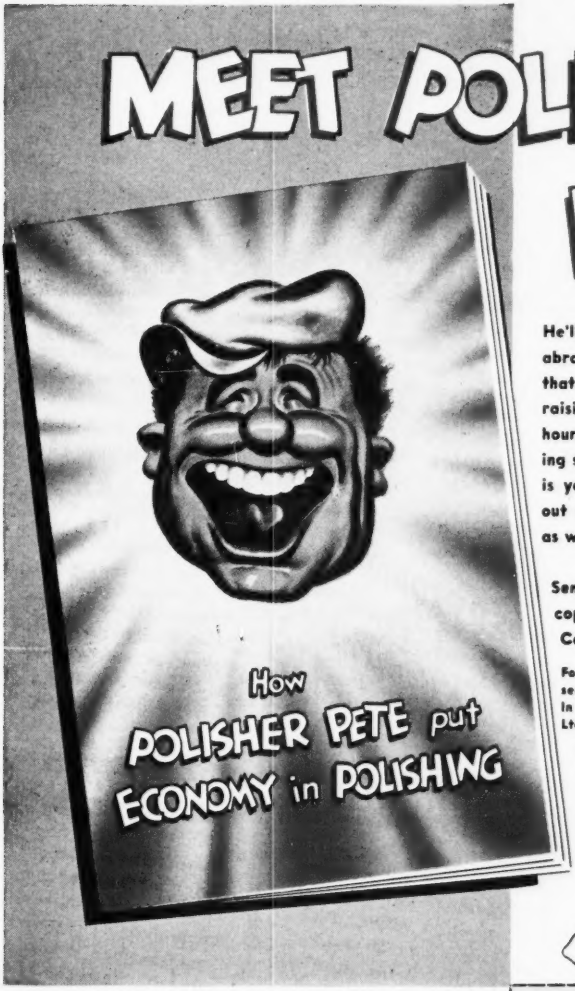

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The Effect of Impurities in Nickel Solutions

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CALCIUM sulphate in a nickel bath causes roughness, pitting and dullness. Filtration readily removes suspended crystals.

CHROMIUM contamination tends, generally, to reduce cathode efficiency and produce deposits in a marked degree of stress. The contaminant can be removed by the Liscomb method, by precipitation at a high pH, or by formation of insoluble lead chromate.

COPPER has the effect of producing dull, dark deposits in the low current density regions, and general fogging of the deposit in other regions. Most effective removal of traces is achieved by a low current density electrolysis at low pH, high temperature and high rate of agitation.

IRON as colloidal ferric hydroxide causes roughness. In a soluble form it codeposits with nickel. This impurity causes one form of pitting. Low current density electrolysis or high pH treatment removes iron.

LEAD causes dark, streaked deposits, and non-adhesion of nickel. Low current density electrolysis removes lead.

NITRATES in a nickel solution strongly depress current efficiency. High concentrations may stop deposition entirely. Electrolytic reduction at the cathode removes this impurity.

ORGANIC SUBSTANCES of many types, including grease, waxes, dust, etc., are detrimental. Their removal usually involves oxidation or carbon filtration, or both treatments.

SULPHUR, in the form of organic compounds, has a brightening effect in many types of nickel solutions. Nickel sulfide is harmful because it results in evolution of hydrogen sulfide and precipitation of sulfides. Although carbon treatment removes some organic compounds containing sulfur, and a high pH precipitates sulfides, there is no general method for removing traces of sulfur compounds.

ZINC in amounts of 0.007 oz/gal is a brightener in dull-nickel plating baths, but higher concentrations yield brittle deposits which may be dark or streaked. The Liscomb method can reduce zinc concentrations. However, low current density electrolysis is the most widely accepted process.

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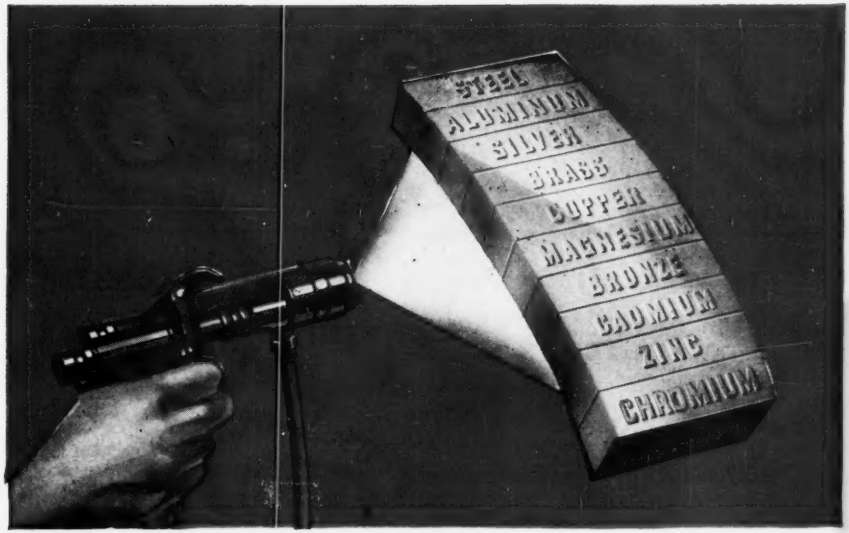

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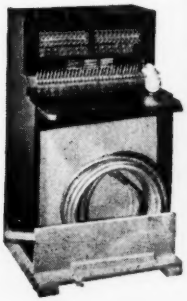

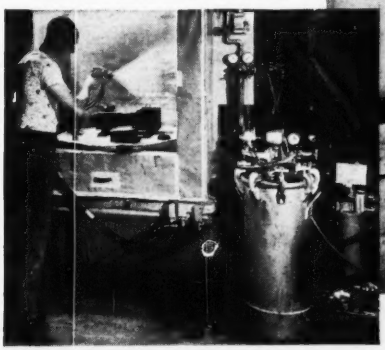

Reconditioned coin-box being sprayed with hot lacquer

CL52-4

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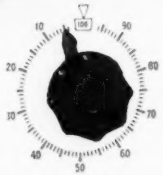

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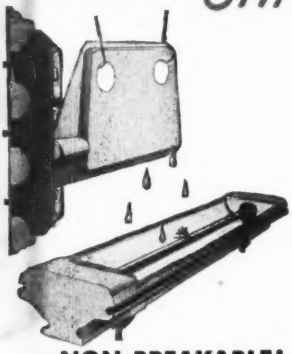

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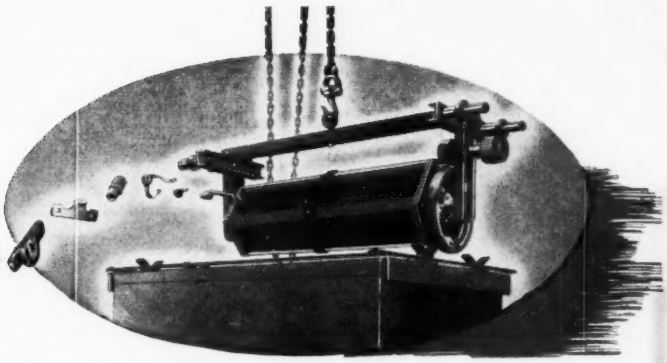

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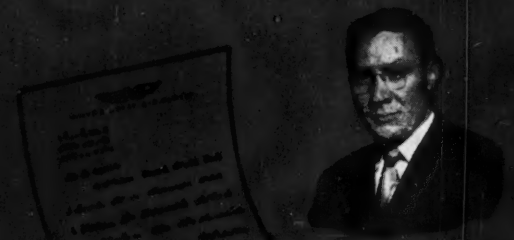


A letter from the Editor

Dear Reader, **SEPTEMBER, 1952**

Visitors to Japan are impressed equally with the energy and activity of the Japanese people, and by the leisurely manner in which business seems to be conducted. Although the pace is far too slow for the American businessman, yet cases of high blood pressure or illnesses normally associated with overwork are rare indeed among Japanese business executives.

For a specific example to serve as an illustration of the Japanese approach to business matters, consider the manner in which a visitor to a Japanese factory or office is entertained. Normally there is no waiting to see the manager or the man to be contacted. The caller is conducted immediately into a reception room furnished with a table and comfortable chairs, and other luxuries in keeping with the prosperity of the company. In summer, cool drinks are served; in winter hot tea and sweet cakes are in order.

Not one executive, but from two to five, greet the visitor. Then, while the visitor (if he is an American) is nervously waiting for an opportunity to plunge at once into the business at hand, the hosts leisurely discuss topics of general interest, observing all the social courtesies possible. The talk finally gets around to the visitor and his business, and if the visitor is the editor of PRODUCTS FINISHING (for example), he is taken on a tour of the plant. After this, the entire group reassembles in the reception room for more tea and discussion. If it is lunch time, lunch may be served, and the visit then assumes the proportions of a social occasion.

Of course, all this takes time, but since most Japanese work seven days per week, a few hours more or less do not matter. The Japanese mixture of pleasure and business has much to recommend it; it's nice work if you can get it!

Ezra A. Blount

—EDITOR

Hot Enamel Provides Finish on American Kitchens

By WALTER RUDOLPH

AMERICAN Kitchens is the trade name of one of the country's top lines of kitchen sinks, cabinets, and other products, produced at American Kitchens Division, AVCO Manufacturing Corporation, Connersville, Indiana. These kitchen cabinets are fabricated of 10 gauge, automobile-grade sheet steel, cold rolled for extra tensile strength and superior finishing qualities. All joints are electric welded in jigs, increasing strength and assuring that corners and the cabinet as a whole will stay square and true permanently, an important factor in designing and finishing.

Comparatively conspicuous compon-

ents of kitchen cabinets are given special attention during cleaning and finishing. Drawer fronts, for example, are manually cleaned by sponging with naphtha, at the same time being thoroughly inspected for imperfections in the surface. Dings and pimples are marked with chalk for mechanical grinding.

Air-powered grinding wheels, employing Behr-Manning or Minnesota Mining 80 grit sandpaper, are used to smooth the weld marks and the marked places (see Fig. 1). The operator goes over the piece a second time with 120 emery cloth to obtain a satin-like finish. The work with the emery cloth is manual.

Most of the metal finishing is done on a group basis. Cabinet doors (all are of two-wall construction, with sound deadening insulation applied inside before assembly) come to finishers on roller conveyor and are removed to individual work tables for inspection. Often skilled die construction and presswork precludes any further operations before cleaning and painting.

But where imperfections are spotted, again the 80 grit power wheels and the 120 grit emery cloth are brought into use. Satisfied with the smoothness of the metal, the worker then returns the door to the roller conveyor where it moves to a gas brazing operation, on either side of the roller. Clenched corners of the two walls are here joined permanently with a momentary application of bronze brazing, manually performed. Doors move on down the conveyor to "hang-on" or storage prior to cleaning.

Sink cabinets are assembled by various steps in resistance welding, ending up at several knee-high finishing tables adjacent to the overhead monorail conveyor that carried them to cleaning painting. Two men take a sink cabinet and place it on one of these work tables. On each side of a work table, located at about waist level, is a powerful incandescent light, and overhead fluorescent lighting fixtures are used.

Thus, the finishers are able to give the cabinet very careful inspection for surface imperfections. Where necessary, they use ding spikes, or pick hammers (two terms for the same tool), and knock out dings or rough spots in the metal. Then the 80 grit sandpaper, with air-powered grinding tool, is used for rough finishing, and final touch-up is done with 120 grit emery cloth.

After the sink cabinet is hung on the conveyor, and as the conveyor moves it along, the cabinet is given another

careful inspection by expert finishers and again smoothed here and there, if required, with emery cloth.

Wall cabinets are assembled by resistance welding, assembly proceeding from man to man in a small group of workers. The completely assembled cabinet ends up at a Y-shaped roller conveyor. At each end of the Y, two men are stationed for metal finishing.

They, too, use ding spikes where required to remove imperfections in the surface, and follow up with the two smoothing operations. A few steps from each of these work stations is another roller conveyor that crosses the top of the Y, and on which the cabinets are placed for manual pushing to the cleaning hang-on station.

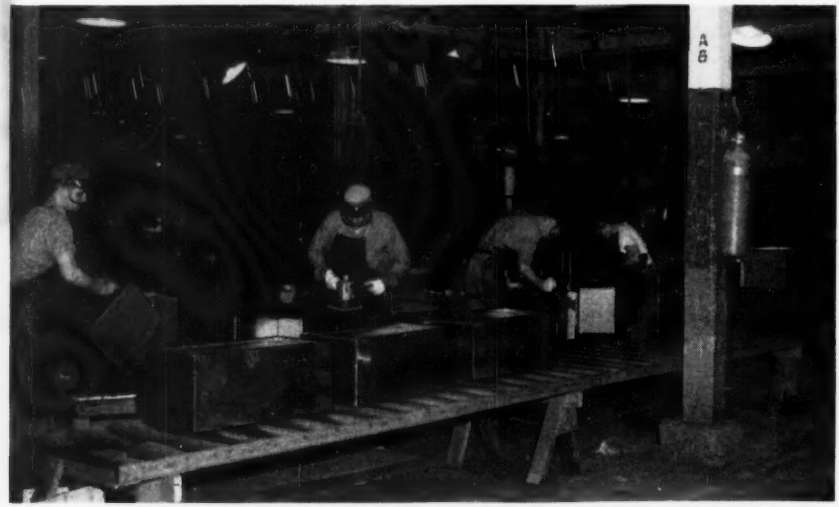
American Kitchens has several conveyorized cleaning and painting setups, one of which has been in operation for some time. A variety of hooks, made of ½-inch steel rod and No. 9 wire, are used to hang cabinets from the chain conveyor which moves at an average speed of 15¾ f.p.m. through successive cleaning, painting, and baking operations.

Cleaning is accomplished in a six-stage spray installation which is completely enclosed. Solutions are collected and recirculated as the overhead conveyor moves over six tanks whose capacities are 4,000, 900, 900, 4,000, 900, and 900 gallons respectively.

Again, in order, the cleaning solutions are alkali cleaner with small additions of Solventol No. 33 held at 180 deg. F; two hot water rinses at 160 deg. F; Bonderite 1000 held at 160 to 180 deg. F.; hot water rinse; and finally Parcolene 3. Solutions are checked continuously by a laboratory technician, the necessary equipment being kept adjacent to the phosphatizing installation. After passing over a 3-minute rinse area, the conveyor leaves the cleaning enclosure and makes a short U turn to enter the drying oven.

We might note here that in maintaining the various solutions encoun-

Fig. 1—At left, welders pass assembled cabinets down roller conveyors to the metal finishers, who in turn place them on a roller conveyor and grind down welds and other imperfections with air-powered portable grinding wheels.



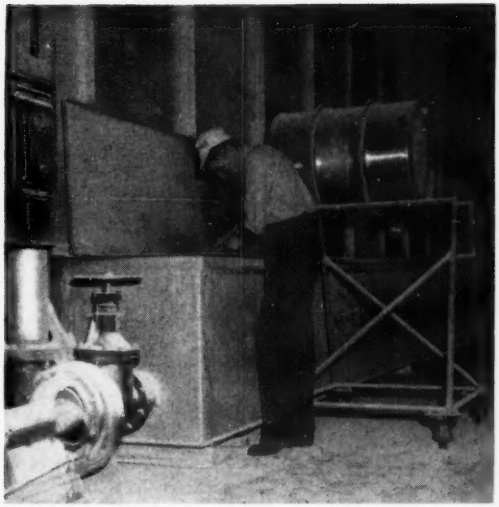


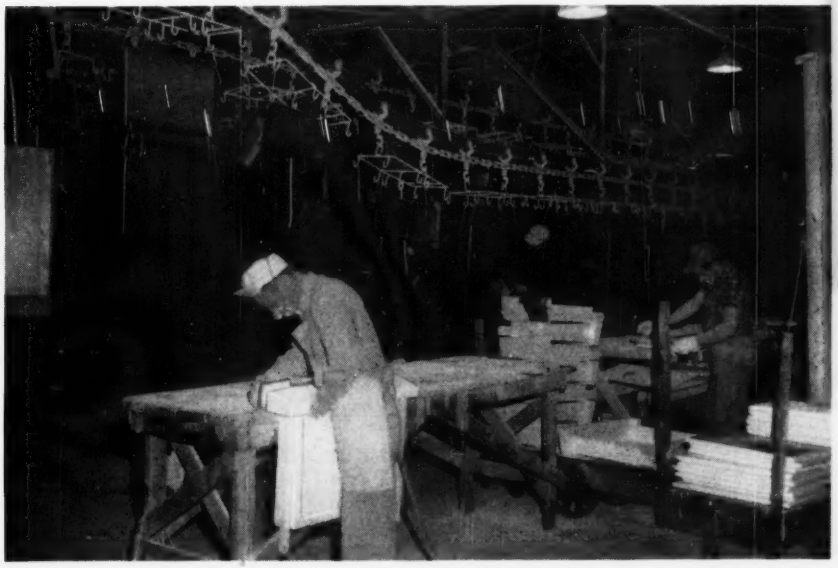
Fig. 2—In the cleaning installation, chemicals are easily added to solutions in tanks that jut into the aisle; note special mobile horse to carry solution drum.

mobile horses upon which drums of chemical compounds can be moved adjacent to the cleaning enclosure (see Fig. 2). The drums can then be positioned to empty right into the cleaning solution tanks, jutting from the sides of the enclosure. Handling of the drums is thus reduced to a minimum.

Total drying time in the oven, designed and installed by the George Koch Sons, Inc., is about 10 minutes. Hot air is circulated

tered in the foregoing cleaning steps, American Kitchens made up several

Fig. 3—View of the area for cooling parts. Following cleaning and drying, pieces are wiped with tack cloth along this line. In the foreground slight imperfections are air-sanded from painted parts.



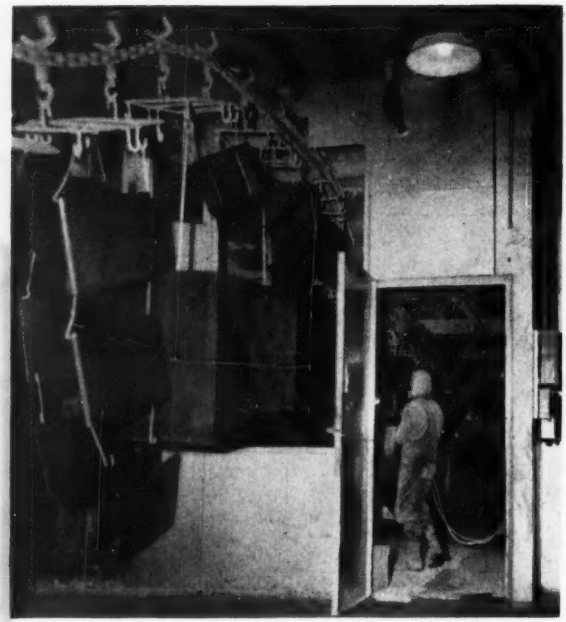


Fig. 4—Looking into the 100-foot paint booth, where two coats of white enamel are applied to American Kitchen cabinet parts. The first painter (center) is applying the prime coat.

through the oven by forced draft fans from oil-fired burners which maintain the temperature at 375 deg. F. After making a U turn in the oven, the conveyor leaves the drying oven and doubles back on itself in a cooling area, shown in Fig. 3. Here cabinets are given a final inspection and wiped with Harding tack cloths.

Parts next enter the 100 by 12-foot, water curtain spray booth (see Fig. 4) to receive two coats of white DuPont Dulux, enamel applied at 160 deg. F. The enamel is heated by Bede Paint Heaters which are located on the outside of the booth. Individual heaters are conected to each of the seven DeVilbiss spray guns.

Air filters, installed along the entire ceiling of the booth, filter the incoming down-draft air which has been preheated to about 72 deg. F. By reason of the use of the hot enamel and warm air, the ground coat flash dries in about 1½ minutes, and the final coat can be applied before the parts leave the booth (see Fig. 5). Water for the water wash is continusously circulated through a 14,000-gallon tank. The conveyor ascends to the bake oven which is located under the roof. The actual combustion chamber, however, is located on the main floor. Three oil burners provide the necessary heat to maintain a temperature of 275 deg. F. in the oven. Although the oven is 700 feet long, actual baking occurs for only a 50-foot distance, the rest of the oven being used for heating and cooling.

Immediately upon leaving the oven and cooling, the cabinets are again inspected. If slight scratches or imperfections are spotted, pieces are rerouted to a work area adjacent to the cooling area traveled by the conveyor between cleaning and painting (see Fig. 3).

Here 150 grit paper is used with air sanders to remove scratched paint, and the piece is hung on the conveyor again for reprocessing through the paint booth. If the finish imperfection is more serious, the piece goes back to another nearby work station and paint is removed right down to the bare metal. The imperfection is removed with the same metal finishing procedure previously described.

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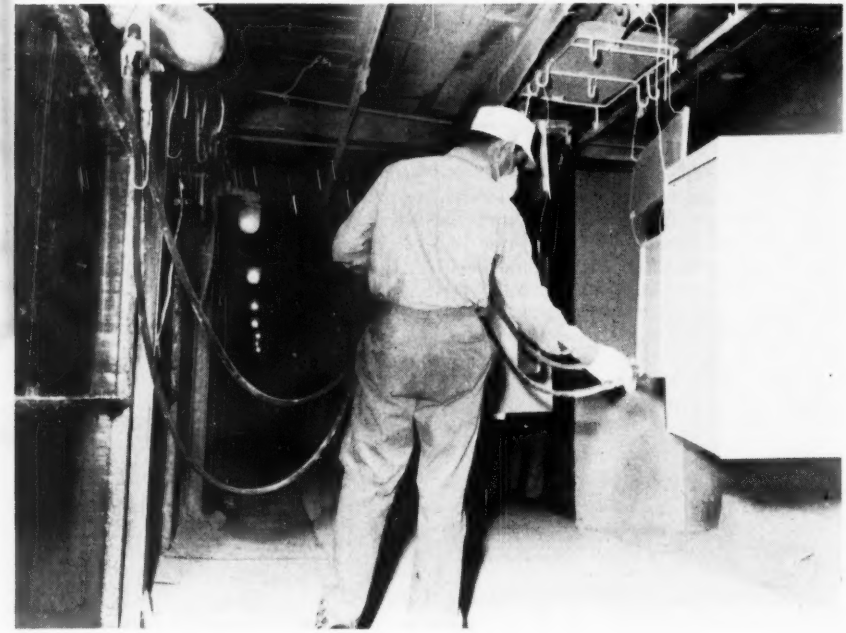
Cabinets and parts, after baking and cooling, are conveyed to the final assembly lines or storage. Near the assembly lines sink cabinets are masked several inches from their bottom edges with tape, and a large wooden frame mask goes over the tape. Then as the cabinets pass a small spray booth, black lacquer is applied with a No. 19 Binks spray gun.

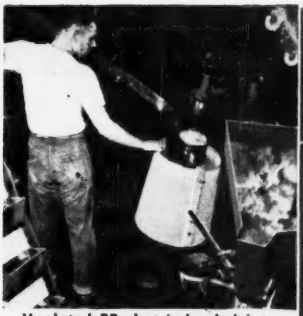
The masks are removed and the lacquer is practically dry when the cabinet leaves the conveyor a few moments later. The quick drying of the black lacquer is due to the fact that the parts have not completely cooled before sprayed. The black strip makes an attractive, durable "kick" strip along the cabinet base.

All parts comprising the various American Kitchen units proceed smoothly through assembly and final inspection. Products are packed for shipment in a locally-designed and manufactured special packaging machine, adding the final touch to a well designed, mechanized manufacturing and finishing process.

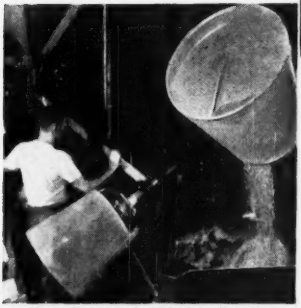
Silver is being clad on stainless steel in a permanent bond by the American Cladmetals Company. The silver surface provides electrical conductivity superior even to copper. The stainless steel backing provides corrosion resistance at sea and structural properties so that silver can be used despite its softness. The two metals are bonded together permanently by means of the Kinney process which is owned by the American Cladmetals Com-Company.

Fig. 5—A view from the exit of the 100-foot spray booth. Note air filters along length of ceiling.





Unplated BB shot is loaded into plating barrel by a chute.



Ater being plated the shot is dumped by the revolving barrel.

This tray receives the plated shot and funnels it into a conveyor.

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BARREL-TYPE PLATING MACHINE AT DAISY MANUFACTURING COMPANY

Stevens Barrel-Type Plating Machine similar to that at Daisy.

Plating air rifle BB ammunition is an unusual application for a huge plating machine, but the Stevens unit at Daisy Manufacturing Company, Plymouth, Michigan, is bringing new profits and efficiency to this operation. Formerly barrel plating was used to give the pellets their copper coating and it was an unwieldy and laborious process.

But with their Stevens machine, Daisy has been able to install an ingenious conveyor system that requires no manual handling from the time the pellets are formed until they are ready for shipping.

If you have a plating problem, call in your nearby Stevens representative or write direct to Frederic B. Stevens, Inc., Detroit 16, Mich.

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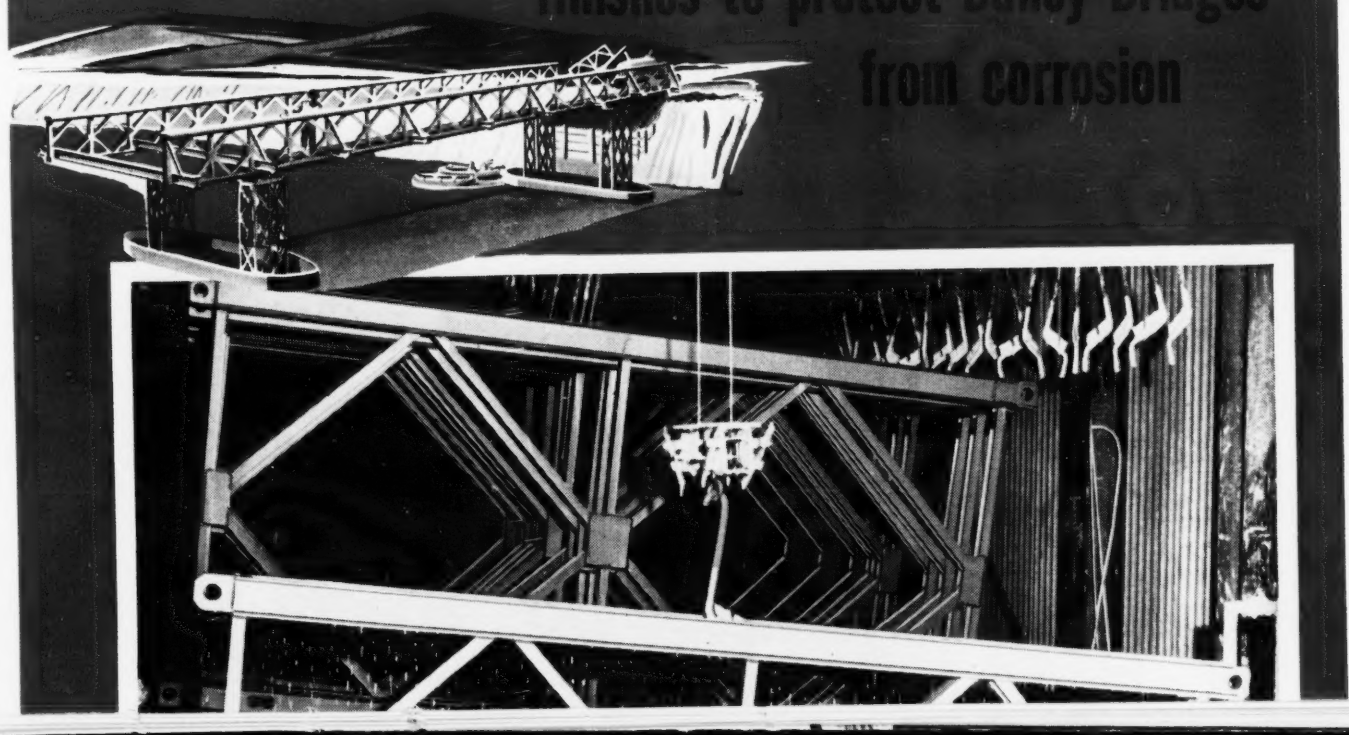
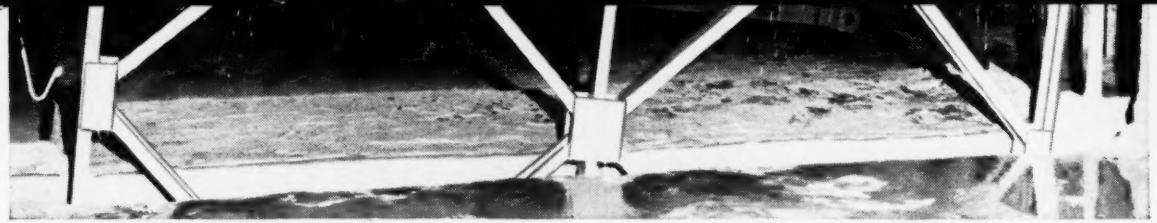
PITTSBURGH supplies plus-over-specification finishes to protect Bailey Bridges from corrosion





Prefabricated section of Bailey Bridge being lifted from dip tank in plant of Commercial Shearing and Stamping Company of Youngstown, Ohio.

PITTSBURGH'S special specification finishes are providing protection against corrosion for Bailey Bridges, the ingenious development of U. S. Army engineers that has been serving our military forces so well in Korea.

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● **Working with Army engineers** and with Commercial Shearing and Stamping technicians, Pittsburgh provided coatings that would be dry for re-coating within two hours. In addition, Pittsburgh suggested improvements in application methods for this step up in production.

● **Pittsburgh is now** also furnishing special finishes for fabricated pontoon bridges being built by Commercial Shearing and Stamping.

● **This is just one more example** of Pittsburgh's ability to provide answers to industrial finishing problems of all kinds. Pittsburgh is in position to assist manufacturers in obtaining information on specifications for finishes. Its technical men can make formula adjustments to meet production requirements and still remain within specification limits. Its service staff can aid in improving application processes.

● **This broad experience** may be helpful in solving *your* finishing problems. Write, wire or phone the Pittsburgh Paint plant nearest you. We'll be glad to have one of our engineers discuss your needs with you, without cost or obligation. Such a call may save you both time and money.

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Surface Tension Control In The Plating Room

By JOSEPH B. KUSHNER

Kushner Electroplating School, Stroudsburg, Pa.

MOST platers and plating executives do not seem to realize the advantages of controlling the surface tension of their plating, pickling and rinse baths. Such control not only conserves valuable materials but has the added advantages of improving rinsing, minimizing contamination and considerably alleviating the nuisance problem of plant waste.

To achieve these advantages it is necessary to employ a surfactant (wetting agent) and a device for measuring and controlling surface tension.

To a large extent, all other things being equal, surface tension controls the amount of liquid that will cling to a piece of work as dragout; if the surface tension of the process solutions is lowered, less of these valuable solutions will cling to the work when it is removed from the tanks.

If a strip of metal such as that shown in Fig. 1 is dipped into a plating bath and withdrawn vertically, a film of plating solution adheres to both sides of the strip. The thickness of this "equilibrium film" depends to a large extent on the "work of adhesion," that is, on the amount of work that must be performed to tear this liquid film away from the strip.

The work of adhesion is given by the expression:

$$W = S(1 + \cos B)$$

where **W** is the work of adhesion in dynes, **S** is the surface tension of the liquid, and **B** is the angle of contact made by the liquid and the metal surface. Since in the case of clean metal surfaces the contact angle is 0 deg. and the cos of 0 deg. is unity, the work of adhesion **W**, is equal to **2S**. As a first approximation, it can be said that the film thickness varies directly with **W** so that

$$F = KW = 2KS$$

where **K** is some constant of proportionality. A 50 per cent reduction in surface tension will thin the film to one half of its original thickness.

Also, as the metal strip is withdrawn, a bead of liquid clings to the bottom edge. This is known as the "edge effect." The longer the strip is held over the tank, the more liquid will drain off from the bead, but soon an equilibrium point is reached where no more liquid drains off, yet a good sized bead still remains. The amount of liquid that remains in this equilibrium bead is also a function of the surface tension. It is given by the expression,

$$V = kLS$$

where **V** is the volume of the bead, **k** is a constant for the given set of con-

ditions, **L** is the total length of the edge and **S** is as before, the surface tension of the liquid.

A reduction in surface tension results in a reduction in the size of the liquid bead held by the edge. Thus, the surface tension of the liquid acts in two ways to determine the amount of liquid the metal strip will retain upon removal from the plating bath. While this analysis was given for a simple strip, it holds true more or less for every type of shape found in the plating room.

Since the surface tension of many plating baths and pickling solutions varies from 70 to 80 dynes, and many common surfactants will lower the surface tension of such solutions to 35 dynes or less, it should be possible to bring about a 50 per cent reduction in dragout losses by just adding a little wetting agent to the plating and pickling baths. Actually such a large reduction cannot be readily achieved because of other complicating factors such as withdrawal velocity, drainage time and viscosity but, everything else being equal, reductions of from 25-40 per cent are easily obtainable.

In addition to the saving of plating or pickling bath by dragout reduction, the danger of contaminating other plating tanks is reduced. Also, the amount of toxic or nuisance salts going into the waste water is reduced.

Some thought and care must be exercised in using the proper type of surfactant, and in controlling the amount that is used. That platers will select the wrong kind of surfactant to use is readily understandable as there are literally hundreds of different kinds on the market. Many of them are precipitated by calcium and other metal salts; many are decomposed by the passage of electricity, many are unstable to heat, acids or alkalies. Some contain molecular linkages that are definitely detrimental to the plate. On the other hand, there are just as many, particularly of the non-ionic types, that are stable to heat, acids and alkalies, that will not decompose with the passage of current and in addition contain molecular configurations that actually help improve the deposit. Not only is pitting minimized through the surface tension reduction, but grain size may be actually refined.

There are a considerable number of these non-ionic types of surfactants on the market today, produced by thirty to one hundred different chemical companies. The plating supply dealer can advise the plater as to stability of surfactant to acid and alkaline conditions, heat and metal salts, so that

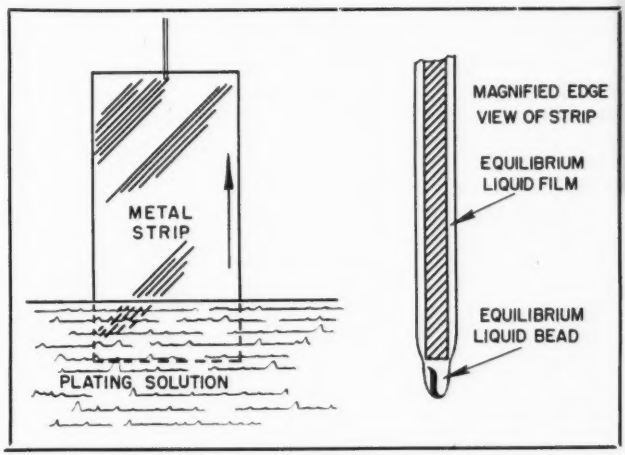

Figure 1

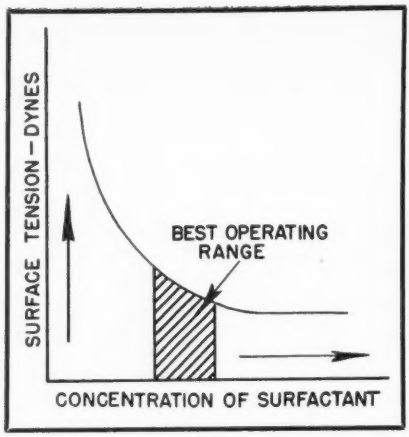

Fig. 2—Typical shape of surface tension control curve.

the surfactants which meet the necessary specifications may be selected. Thereafter a simple test, using the proper amount of material, in a small test tank will show quickly whether the material is harmful to the plate. If it gives no bad results in the test cell, it will do no harm in a big tank.

This writer has found by experience that in most cases where a wetting agent caused a plater trouble, he had used far in excess of what was actually required. It is very easy to use too much of a wetting agent, good or bad, because usually the amount that is required in a plating bath is about 0.02 to 0.03 per cent, which is a very small amount indeed. A 0.02 per cent solution of a liquid surfactant, for example, would consist of about 16 drops in a gallon of plating solution. These surface tension depressants are of an organic nature and an excess present in the plating bath can cause trouble, just as an excess of brightener may cause trouble.

The surfactant is used up at a relatively rapid rate. The reason for this lies in the nature of the animal. It is surface active so it goes to all surfaces wherever they exist, as indicated in Fig. 3. Thus, higher concentrations of the surfactant will be found on the work surface than may exist in the main body of the solution. This being so, every time work is removed from the bath, it takes along an amount of wetting agent out of proportion to the amount that exists elsewhere in the solution. Accordingly a means for determining the surface tension of the plating bath and the amount of surfactant that must be added to keep it up to par, is required for surface tension control.

Up to the present, little effort has been made to control the surface tension of solutions in the plating room. The De Nouy type of tensimeter is a delicate, costly instrument that can only be operated by a highly trained technician. The stalagmometer, a capillary tube type of device calls for tedious cleaning procedures as well as a time consuming measuring technique involving the use of a stop watch, a counter, or a balance.

Recently there has been developed a simple surface tension measuring

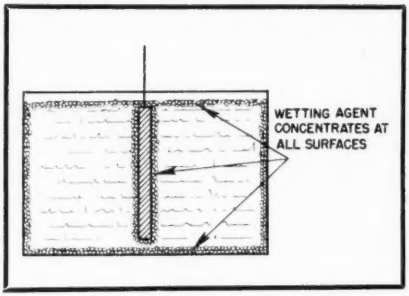

Figure 3

Fig. 5—Measuring surface tension at the tank with a Sur-Ten Meter
(Photo courtesy Pocono Metal Products Company)

device* based on the capillary rise of liquids between two inclined glass plates, that puts in the realm of complete practicality the quick and easy measuring of surface tension in the plating room. The device, called the "Sur-Ten-Meter" is illustrated in Fig. 4. It can be used by anyone without previous training and permits surface tension measurements to be made in less than 5 minutes. The Sur-Ten-Meter can be used right in the plating tank as shown in Fig. 5, or in its own miniature lucite testing tank which holds approximately 200 cc. of solution. The scale reading at the point where the liquid curve cuts the scale is a direct index of the surface tension of the solution being tested.

To verify the value of surface tension control in reducing dragout losses, the writer performed two simple tests on an acid copper solution on a semi-plant scale. The solution as made up contained 30 oz. per gal. of copper sulfate and its surface tension as determined by the Sur-Ten-Meter was 78.2 dynes at room temperature. A cleaned strip of stainless steel 6 by 2 inches was dipped into the copper solution and removed at a rate so that the bottom of the strip cleared the solution line in five seconds. A similar drainage period of five seconds was taken over the tank, then the strip was immediately plunged into a two-gallon standing rinse of clear water, and thoroughly agitated to bring about complete mixing. This procedure was repeated fifty times, after which time an analysis was made of the copper sulfate content of the rinse tank. The concentration of copper sulfate in the two-gallon rinse tank was found to be 0.16 oz. per gal. Making use of a method proposed by the writer several years ago for determining dragout volume, the actual volume of dragout was calculated with the following formula:

$$\phi = CV/C_0 n$$

* Patent Applied For by Joseph B. Kushner.

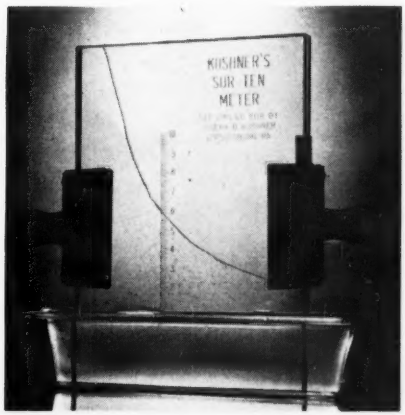

Fig. 4—The Sur-Ten Meter

For more complete information on products and processes use READER SERVICE CARDS inside covers.

where ϕ is the volume of dragout per piece in gallons, **C** is the concentration of copper sulfate in the rinse tank, $\mathbf{C}_0$ is the concentration of copper sulfate in the plating tank and **n** is the number of times the piece has been dipped in the rinse tank. Substituting in the values obtained gave $\phi = 0.0002$ gal. as the dragout volume for the strip.

The surface tension of the same copper sulfate solution was now lowered to 35 dynes by the addition of a surfactant called Antarox, using the Sur-Ten-Meter to control the addition. The same dipping process was started as before, with fresh water in the rinse tank. After fifty dips an analysis showed 0.09 oz. per gal. of copper sulfate in the rinse tank. Accordingly, the dragout volume with surfactant present was then 0.0001 gal. Or, in other words, lowering of the surface tension of the acid copper solution resulted in a reduction of about 50 per cent in the dragout volume.

Similar savings can be effected in the case of other solutions, and operating costs reduced accordingly.

REFERENCES

1. "Practical Surface Tension Secrets for Platers" published by the Joseph B. Kushner Electroplating School, Stroudsburg, Pa.
"Dragout Control", Metal Finishing, Nov., 1951, p59.
2. "A New Device for Simplified Surface Tension Control", Plating, Vol. 38, No. 9, p. 933. (1951)
3. "Measurement of Dragout" Metal Industry, 1939, p. 320.

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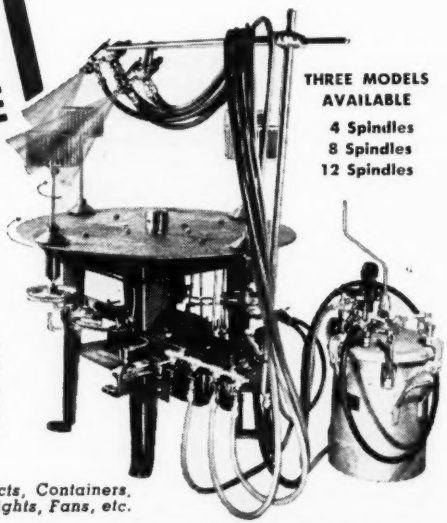

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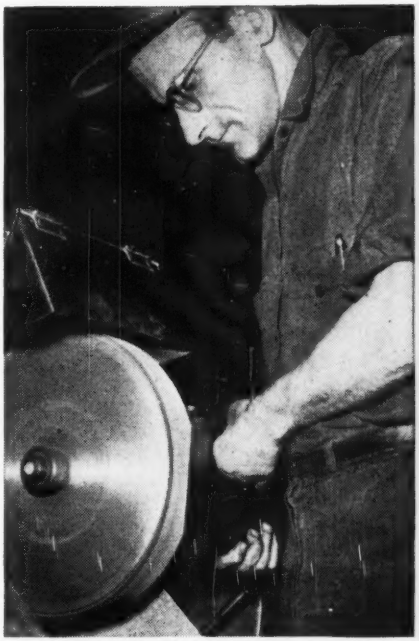

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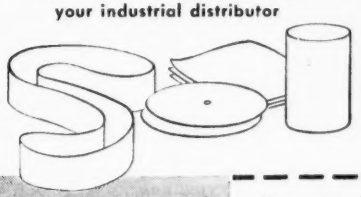

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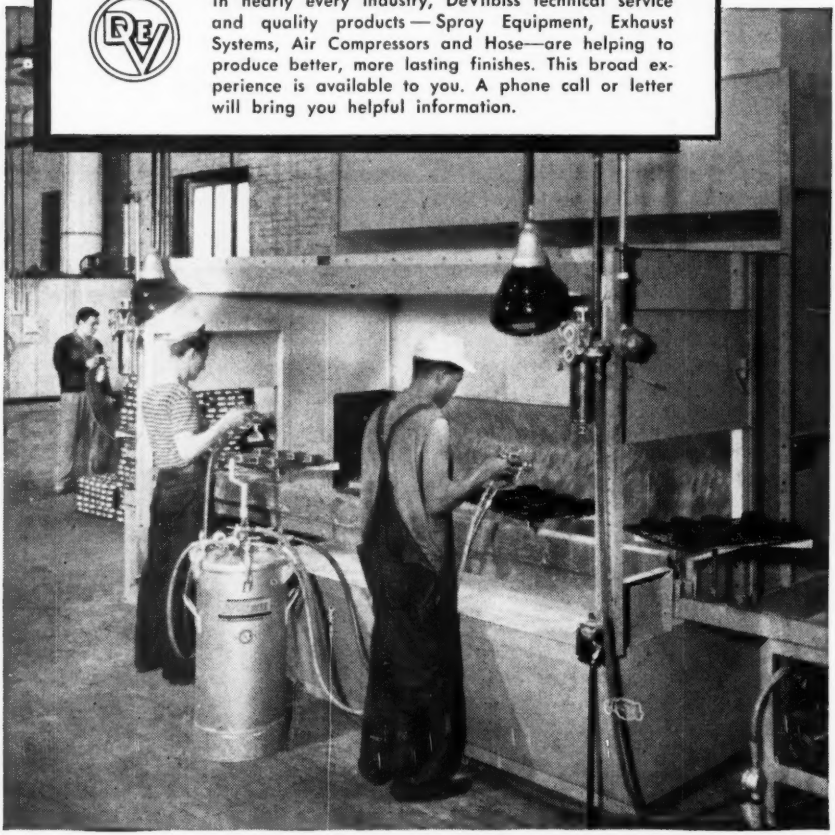
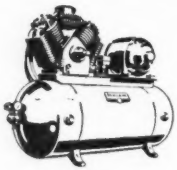


This DeVilbiss conveyorized finishing setup helps small-parts manufacturer spray-paint hundreds of parts per hour.



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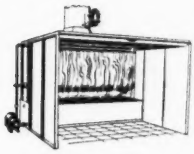

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MEET THE MASTERS

By S. C. TAORMINA*

IN the early thirties the N.R.A. stimulated the organization of hundreds of trade associations. But by that time the Masters' Electro-Plating Association, made up of owners or operators of job plating shops in the New York City area, was already sixteen years old. It was founded in 1917 by eighteen (18) charter members.

With this hardy group as a nucleus, the Masters' Electro-Plating Association, or M.E.P.A., has grown to ninety (90) members who do about 75 per cent of the total job plating and finishing business in this area. A good share of the credit for its development can be attributed to the efforts of the late Adolph Bregman, executive secretary from 1934 to 1951. With infinite patience and hard work he held the Association together through the depression and the tense war and post-war periods.

The growth of M.E.P.A. parallels a period of the most intensive experimental and research work in the electroplating field. As a result, the art of electroplating emerged as a science and its practice became a real challenge to the best technical brains in the land.

One of the most important functions of M.E.P.A. is to provide for its members information concerning all the known processes and the new ones as they are developed. The M.E.P.A. has at its disposal information not easily obtained elsewhere concerning these processes, methods and techniques. Members obtain specific answers to questions by merely telephoning the Association offices. Very often, not only technical information but the economic aspects of the processes are of immediate concern. The time and trouble saved by the members in obtaining answers quickly cannot easily be calculated.

The Masters' Electro-Plating Association publishes a monthly bulletin which is sent free of charge to each

* Executive Secretary, Masters' Electro-Plating Association Inc., New York.

* Technical Director, Platers Technical Service, Inc., New York and Chicago.

member. The bulletin features:

1. A front page "Rate of Operations" report which shows at a glance the state of business conditions in the job shops. This information is very valuable to the job shop operator inasmuch as it tells him whether his shop is obtaining its share of the available business.

2. Information concerning the state of business in New York City, the state, and the nation.

3. Information concerning the current supply situation and the availability of metals, chemicals and so on.

4. The latest Government Regulations affecting the use and purchase of scarce materials, news of state and local ordinances affecting the job shops and news of the various Government Bureaus.

5. News of other Job Shop Associations.

6. A resume of what transpired at the previous regular meetings so that members who were unable to attend are kept up to date on the activities within the Association.

7. A technical section which presents the technical aspects of electroplating and finishing from the point of view of the job shop operator.

The members of the M.E.P.A. are alert to the need of training young men and women in the various techniques. A young man wishing to learn the practical aspects of electroplating and finishing can find no better training ground than the job shop. It is there that a new challenge to his skill is presented every day of the year. For the broad training he can obtain in the job shop cannot be had in captive shops where only one or two types of finishes are produced. In general, a trainee will find the going rough in a job shop, but when his training period is over he will know something about practical electroplating and finishing.

The Association helps members obtain business through Government Agencies, helps platers settle labor disputes, clears up misunderstandings among members and creates good fellowship toward solving common problems. Two questions are always asked

Members of the Executive Committee. Standing (left to right): John J. Forbath, Star Chromium Corp.; Philip Ranno, Imperial Plating Co.; Philip Sievering, Philip Sievering, Inc.; Sal Novelli, Service Plating Co. Seated (left to right): Irving Berkman, Berkman Bros.; S. C. Taormina, Executive Secretary; Frank Kaiser, Chairman, L. I. Mechanical Plating Co.; Sidney Rosenthal, National Chromium Corp.; Joseph F. Brust, Brust Bros., Inc. Executive committee-men not present: Jesse Goldman, Grand Chromium Plating Corp.; L. A. Korr.blum, Kings Electro-Plating Co.; Julian Nelkin, Henry Nelkin, Inc.

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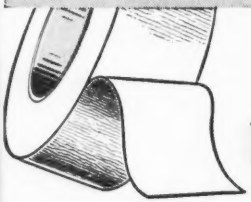

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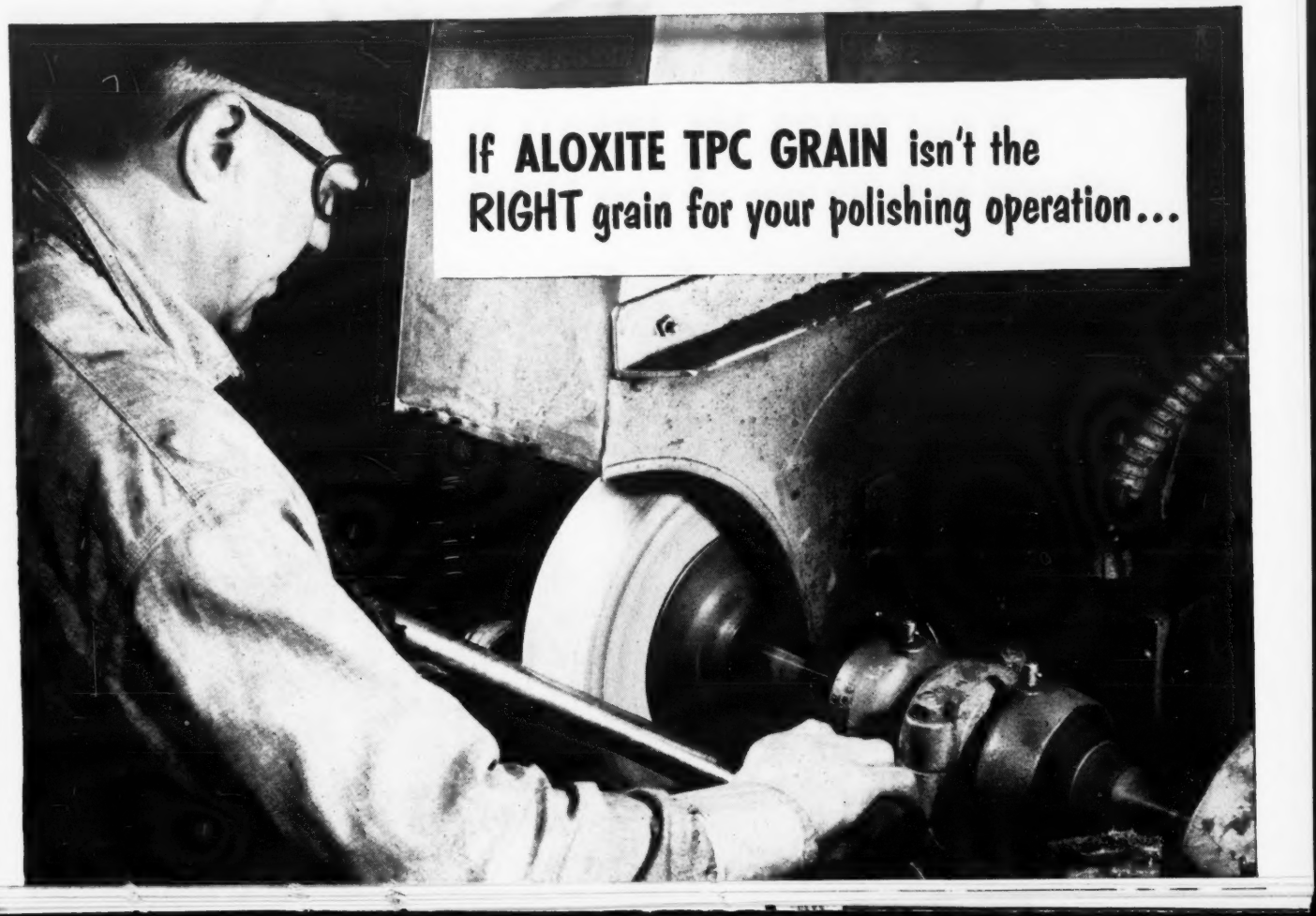
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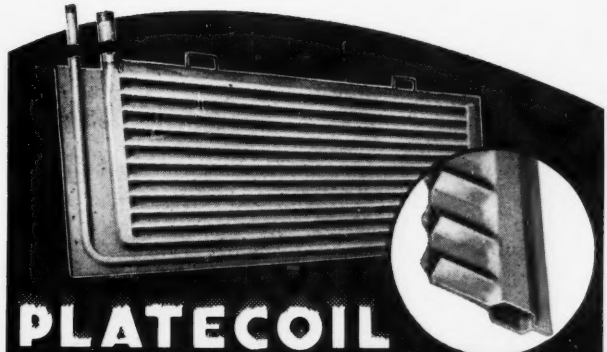
Chromic Acid Anodizing To Meet Military Specifications

ACCORDING to Herberth E. Head, Briggs Manufacturing Company, Detroit, the 250-hour salt spray specification for anodized aluminum required by military specification AN-QQ-A-69a can be met with 30 minutes treatment time in a 2.5 per cent chromic acid solution. Mr. Head recently discussed the practical aspects of chromic acid anodizing before the St. Joseph Valley Branch, American Electroplaters' Society. Ordinary tap water may be used to prepare the anodizing bath provided the chloride content of the water does not exceed 0.12 gm./l. Chemical methods of analysis are given in specification AN-O-A-81.

The chromic acid anodizing bath is maintained at a pH value between 0.85 and 1.0 and at a specific gravity of from 1.075 to 1.091. The pH and composition of the solution are controlled by drawing off a part of the solution and adding water and fresh chromic acid. Under these conditions, a film thickness of approximately 0.00004-inch will be produced at a current density of about 2 amp./sq. ft. The anodizing bath is maintained at a temperature of 95 $\pm$ 5 deg. F. In starting the anodizing operation it was recommended that the current be turned on as low as possible and raised gradually until it reaches 40 volts, where it should be held constant for a 30-minute period. A time period of 6 to 8 minutes should be used to raise



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LOW FIRST COST

The initial cost of Platecoil is often 50% or more below the cost of equivalent pipe coil depending, of course, on the materials used in construction

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the voltage to 40 volts. If this practice is followed, the voltage will remain constant after 40 volts.

In discussing the various types of equipment for anodizing that have been investigated at Briggs, Mr. Head pointed out that the synchronous motor driven generator was found to have the most constant output voltage, a desirable feature in anodizing aluminum for aircraft use. When calculating the capacity of low voltage equipment for anodizing it is good practice to use as a basis 8-10 amp./sq. ft. for each square foot of work that the tank will hold. Then, at 40 volts, the steady operating current density will vary between 1 and 3 amp./sq. ft.

The tanks used for chromic anodizing are made of steel, and the tank acts as the cathode in the circuit. Due to the high voltage used, it is important that the work not be short-circuited to the sides or the bottom of the tank. This will cause a breakdown of the coating and eventually will ruin a whole tank load of work. Because of this, the bottom and sides of the tank must be protected with insulating material. A number of different insulating materials have been tried at Briggs, among which are acid resisting porcelain enamel applied to perforated steel, ¼-inch hammered wire glass, and sheets of "Herculite" heat-treated glass spaced about ¾-inch apart. The bottom of the tank is protected with a layer of acid proof bricks without cement joints. Air agitation during operation assists in maintaining an even temperature. The tank is fitted with coils on both sides so that steam or cold water can be used to maintain the proper temperature.

According to Mr. Head, it is considered good practice to vapor degrease before anodizing to remove oil and grease from the parts before they enter the cleaner tank. An ordinary type of steel cleaner tank is used. Cleaning

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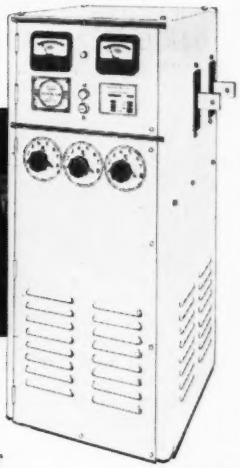

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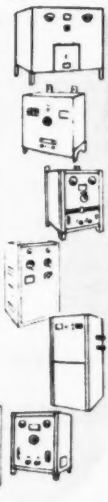
For increased production, improved quality, fewer rejects, lower labor costs—which translates into higher profits—use Richardson-Allen dependable rectifiers.

The basic R-A Rectifier is widely used where a single voltage or current is needed or where several rectifiers are to be paralleled.

For electroplating chrome or bright nickel a 22-position tap switch is supplied. For electroplating gold or silver, and for anodizing a 36-position tap switch is used.

A special Heat Exchanger unit is available for use in corrosive atmospheres. This R-A development permits operation at elevated ambient temperatures with a minimum temperature rise. Long, uninterrupted, dependable service is assured.



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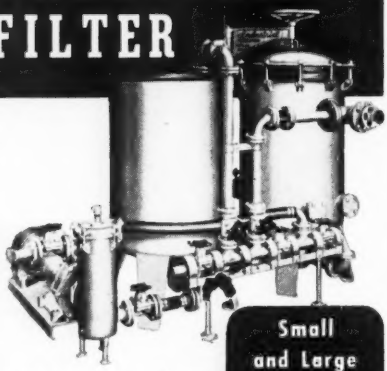

The flow rate of an INDUSTRIAL filter is based on the actual solution involved. You know the capacity you get. Furthermore, the labor, down time, and the inconveniences of cleaning, replacing the filter media, and reassembling the filter for every filtering cycle—all are eliminated by the Industrial Air-Wash Cleaning Method available for all models. It is necessary to remove the cover only when new filter cloths are installed. With Industrial filters, a clarified solution is always assured.

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INDUSTRIAL FILTER & PUMP MFG. CO.

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is followed by rinsing. Parts are immersed in the anodizing solution with no current on at the time of immersion. Parts are racked on aluminum racks covered with a suitable protective rack coating. It is important that the anodizing solution does not come in contact with copper, brass or steel rack materials. Aluminum rack contacts must be cleaned either chemically or mechanically after use, to remove the insulating coating. Filing is common practice; chemical cleaning may be done in a boiling solution of phosphoric acid (5.6 fl. oz./gal.) with chromic acid (2.8 oz./gal) or in a 6 oz./gal. caustic soda solution, at 150 deg. F., until gassing appears at the contact points.

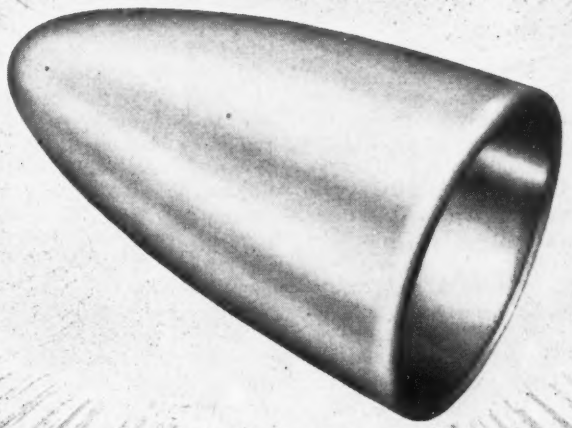
* * *

Silicone Coatings Protect Under Severe Conditions

SILICONE vehicles for baking enamels offer the possibility of securing high temperature and weather resistant flexible coatings not previously available. An appraisal of tests, recently reported by C. E. Arntzen and R. D. Rowley, Materials Engineering Dept., Westinghouse Electric Corp. in "Materials and Methods," indicates that silicone enamels are far superior in heat and weather resistance to any of the conventional organic coatings. In addition they exhibit excellent resistance to discoloration. Silicone type finishes can be applied in the conventional manner by dipping or spraying. The baking temperature (300 to 400 deg. F.) required, however, is somewhat higher than that for other organic coatings.

The silicone vehicles are alkyl-aryl-copolymers and can be produced with various degrees of flexibility, thermoplasticity, and mechanical strength by varying the ratios of the alkyl-aryl and the organic groups to the silicone

. . unharmed
by 250 hours of Salt Spray



Here is laboratory proof that dramatizes the stubborn protection given by a Randolph Finish.

This aluminum lighting fixture part—with one coating of Randolph Clear Baking S. G. Enamel Y-7300—was bombarded for 250 continuous hours in the Salt Spray (Fog) Chamber of a nationally-known testing company. Exposed to these severe moisture conditions, the part emerged without a flaw on its perfect surface.

Here is product-protection that never yields under the severest test! And that's not the whole story of Randolph quality. Randolph Finishes make your product look better, serve better and wear better—at lower costs!

We'll be glad to send you a free sample of Clear-Baking S. G. Finish Y-7300 if you write us. Any time you have finishing difficulties, call on our able technicians for help. They specialize in solving finishing problems.

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RANDOLPH PRODUCTS CO.

CARLSTADT, N. J.

atoms. Since heat resistance is an outstanding property sought in silicone finishes, the pigment used with the vehicle must be selected with this in mind. The most heat resistance silicone finishes are those pigmented with the normal percentage of aluminum powder. These finishes will withstand 930 deg. F., for a few hours and 750 deg. F. for as much as 100 hours before there is considerable film failure and loss of adhesion. The best white enamels are those containing titanium dioxide extended with calcium sulfate. Such enamels have been held at 500 deg. F. for 500 hours without cracking or checking. While the silicones will not withstand as high temperatures as porcelain enamels, they do permit the attainment of higher temperatures than possible with other organic finishes.

Alkyd silicone finishes have been prepared by the addition of a silicone containing material during the processing of the alkyd and also by mixing of alkyds and silicones after they have been prepared separately. Several concerns are marketing alkyd silicone finishes. These modified silicone resins possess a heat resistance, intermediate between the alkyds and silicones and also show some improvement in adhesion to metal over silicones alone.

The Westinghouse tests also showed that the silicone finishes had unusual durability. A white enamel showed no evidence of checking, cracking, chalking or loss of gloss after 4 years of exposure to weathering. Alkyd resin finishes faded and chalked badly under the same conditions. This weather proofness of silicone finishes is attributed in part to the combination of water repellence and low moisture absorption. Typical present day uses for silicone finishes are for coating ovens, smoke stacks, exhaust manifolds, kitchen ranges, furnaces, boilers, motors and chemical plant equipment. A modified silicone coating maintains the Army's olive drab finish on a 500 deg. F. heater made by Southwind Division, Stewart-Warner Corp. As costs become lower through increased production and by modification with other resins, undoubtedly many other applications will arise.

* * *

Plating Cobalt-Tungsten-Molybdenum Alloys

CONDITIONS for deposition of a ternary alloy of cobalt-tungsten-molybdenum were reported at the 100th meeting of the Electrochemical Society, held in Detroit, by Dr. M. L. Holt, based on work conducted in conjunction with R. F. McElwee at the University of Wisconsin. Since neither tungsten nor molybdenum has been electroplated alone in appreciable amounts from aqueous solutions, it was felt that electrodeposited ternary al-

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NOT MOTTLED
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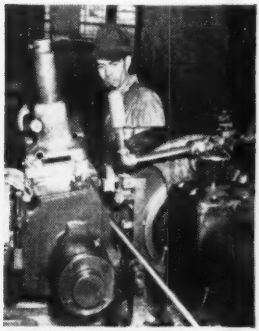

CENTERLESS BRUSHING. This centerless grinder does double duty in the production of nickel-moly steel pump rods. As a grinder, it rough-grinds, then finish-grinds the rod. Then wheel is replaced with an Osborn Fascut Brush for obtaining of smooth finish. Makes rods and pump packing last longer.

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loys containing these two metals would be of interest for a number of possible applications.

All plating solutions used in this study were prepared from sodium molybdate, sodium tungstate dihydrate, cobalt sulfate heptahydrate, and citric acid monohydrate. In preparing the baths, the desired amounts of cobalt sulfate and citric acid were first dissolved in water and then the sodium molybdate and sodium tungstate were added. The pH of the solution was adjusted by the addition of ammonium hydroxide solution or dilute sulfuric acid.

Hull Cell Used to Chart Plating Characteristics

The experimental work was organized to bring out the effects of such factors as bath composition, bath pH, and bath temperature on cathode current efficiency and on the appearance and composition of the cathode deposits. Preliminary qualitative information was obtained with the Hull Cell but all quantitative information was obtained using regular plating procedures. The Hull Cell used was the 267-ml. model operated with a current of 3 amperes. The appearance of the Hull Cell cathodes was used as a measure of the effect of various changes in bath composition over a pH range of from 2 to 10.

To study the effect of sodium molybdate concentration, a solution of the following composition was used: 60 gm./l. cobalt sulfate, 40 gm./l. sodium tungstate, 66 gm./l. citric acid and variable amount (2, 10, 20, 30, or 40 gm./l.) of sodium molybdate. Each bath with a given concentration of sodium molybdate was used at pH values of 2, 4, 6, 8, and 10. The resulting Hull Cell cathodes indicated that a bath pH of 4 is best for all concentrations of sodium molybdate. Similar studies, wherein the concentrations of sodium

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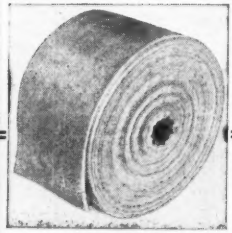

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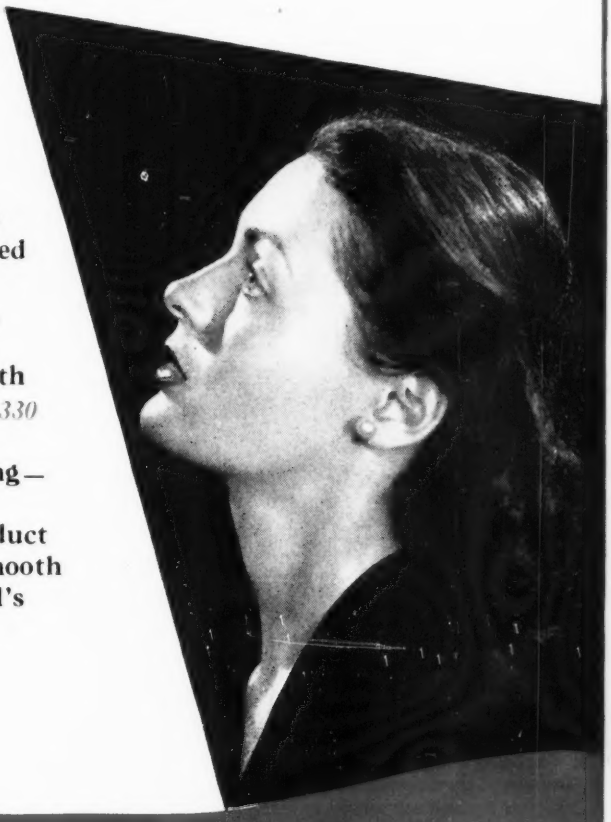
Smoothen



When scratch-free chrome plated finishes are required . . . *Smoothen* **scratches with** *SIEFEN'S S 330* **and** ***Sisals*** **before plating— then your finished product will be as smooth as the model's appearance.**

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News about UNICHROME

Trade Mark

Primer protection for modern metals

Unichrome Primer AP-10 offers the two properties that insure durable finishing of magnesium, aluminum, steel and other metals. (1) Resistance to corrosion even by itself. (2) Strong adhesion even under tough service conditions. That's why it actually improves the life of finish coats. For example: Magnesium panels were primed with AP-10; others with a standard primer. All were given identical finish coats and then tested in salt spray. After 100 hours, panels with Primer AP-10 had developed no corrosion, whereas the others had failed completely.

Remarkable Improvement in Chromium Plating

Hard chromium plating in the Unichrome S.R.H.S. Chromium Solution reduces plating time, control problems, finishing time, and costs. Here's why: This solution plates 20 to 80% faster than the ordinary bath. It plates with less "treeing" and levels over minor surface irregularities. A self-regulating bath, it needs less attention for good results. Impartial tests have also shown that S.R.H.S. Chromium minimizes loss of fatigue strength of chromium plated steel parts.

Florida test shows this

Offers longer

EVEN THOUGH AIR DRYING!
EVEN THOUGH HALF AS THICK!

Here's a case history that illustrates the exceptional protection that can be obtained for bright finishes with Unichrome Clear Enamels.

Over 70 coatings for chromium were subjected to year-long Florida exposure tests by a well known company. Most were baking types. Unichrome Coating A-140 was one of the few air-dry coatings. It was applied to a thickness of 0.4 mil, as against 0.8 for the others. Despite this, it was the coating that stood up best by far in the entire test group, being as good as new at the end of the test.

ESPECIALLY NEEDED TODAY

Many bright finishes today are often combination finishes. They retain the eye-appealing advantage of a bright

PLASTISOL COATING MAKES IDEAL RACK INSULATION

One particular green, vinyl-base, plastisol coating is being widely used in plating plants wherever racks are worked long and hard. For these reasons: Unichrome Coating 218X doesn't crack or chip even after long service. It resists all plating, cleaning and anodizing solutions and vapor degreasing cycles. It has unsurpassed adhesion when applied over a single coat of Unichrome Primer 219-PX. It minimizes contamination of solutions, rinses freely.

COATINGS for METALS

Metallic . . . . . Organic . . . . . Decorative . . . . . Protective

Unichrome Clear Enamel

lasting protection to bright finishes

plate but make use of an organic coating to supplement the corrosion resistance of metallic finishes that do not possess adequate corrosion resistance in themselves. Through their long life, Unichrome Clear Enamels can make a combination finish a *high quality* finish. They offer other advantages, too.

MONEY-SAVING EXAMPLE

Chromium plated refrigerator shelves, for example, require extra protection at the welds. The clear enamel to provide this must resist moisture, handling and corrosives. Using a special Unichrome Clear Enamel, a well known manufacturer is getting not only superior protection but also greater film thickness at less cost than the coating formerly used. Savings reported for the year amounted to $15,000.

GOLD OR BRASS COLORS

Supplied with lightfast color concentrates, Unichrome Clear Enamels simulate gold or brass colors when applied to chromium, bright zinc conversion coatings or polished stainless. The durability of the coatings assures a long lasting finish. Simple control of the color concentrate by the user permits close matching of parts.

★ ★ ★

Among the many Unichrome Organic Coatings developed for both protection and eye appeal, there's probably one to help *you* with your specific problem. Write or phone the nearest United Chromium office.

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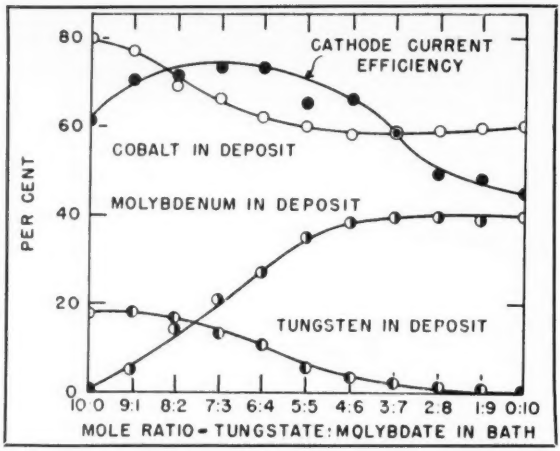

Fig. 1—The effect of the tungstate-molybdate mole ratio on cathode current efficiency and composition of the cobalt-tungsten-molybdate deposit. Baths contain (per l.): 0.23 mole of cobalt sulfate, 0.31 mole of citric acid and a total of 0.23 mole of sodium tungstate plus sodium molybdate in the ratios indicated. Bath pH 4; Temp. 25 deg. C.; cathode current density about 50 amp./sq.ft. (*Illustration courtesy The Electrochemical Society, New York 27, N. Y.*)

tungstate and cobalt sulfate were varied, also indicating that a bath pH of 4 was best for operation of the plating system.

To make comparative values more significant the concentration of each bath ingredient was expressed in terms of moles per liter instead of grams per liter. To study this concentration effect, baths were made up containing fixed amounts of cobalt sulfate and citric acid and variable amounts of total tungstate plus molybdate, but with a 1:1 mole ratio of tungstate to molybdate. The baths were made up to contain 0.23 mole (64.5 gm.) per liter of cobalt sulfate, 0.31 mole (66 gm.) per liter of citric acid, and decreasing amounts of total tungstate plus molybdate (1:1 mole ratio) from 0.46 mole (76 gm./l. sodium tungstate plus 47.5 gm./l. sodium molybdate) to 0.057 mole/liter. The pH used was 4 and the bath temperature was 25 deg. C. in each case. The Hull Cell test plates showed that as the concentration of tungstate plus molybdate in the bath decreased, the appearance of the plates became progressively better until a concentration of 0.057 mole/liter gave a mirror bright surface over the whole Hull Cell cathode.

A number of baths were prepared with 0.23 mole/liter of cobalt sulfate, 0.31 mole/liter of sodium tungstate plus sodium molybdate in varying mole ratios. The ratio of tungstate to molybdate was varied from 10:0 (0.23 mole of tungstate, no molybdate) to 0:10 (no tungstate, 0.23 mole of molybdate). Regular plating procedures were used to obtain quantitative information about the electrodeposition of alloys from these baths. The baths were adjusted to pH 4 and maintained at 25 deg. C. during electrolysis at about 50 amp./sq. ft.

Figure 1 shows the cathode current efficiencies and the analyses of the cathode deposits obtained from these baths. It can be concluded from these results that the effect of the concentration of molybdate in the bath is much more pronounced than that of the tungstate. The highest current efficiency was obtained in baths having tungsten:molybdenum ratios of 7:3 and 6:4. The best appearing deposits were obtained from baths having mole ratios of from 8:2 to 5:5. At the high tungsten end of the series the deposits tended to flake off the cathode and at the high molybdenum end of the series the deposits became streaked and discolored. On the basis of these results,

AMERICAN CHEMICAL PAINT COMPANY

AMBLER CHEMICALS ACP PROCESSES PENNA.

Technical Service Data Sheet
Subject: INDEX OF ACP CHEMICALS FOR METAL PRESERVATION AND PAINT PROTECTION

METAL	OPERATION	ACP CHEMICAL
IRON AND STEEL	*Chromate Coating, in Preparation for Painting*	"CROMODINE"
	Cleaning	"ACP RIDOLINES AND RIDOSOLS"
	Cleaning for Painting	"DEOXIDINE" "DURIDINE"
	Coating with Copper	"CUPRODINE"
	Drawing and Extrusion	"GRANODRAW"
	Paint Bonding	"CROMODINE" "DURIDINE" "GRANODINE" "PERMADINE" "THERMOIL-GRANODINE"
	Paint Stripping	"CAUSTIC SODA AND SOLVENT NO. 3"
	Phosphate Coating, in Preparation for Painting	"DURIDINE" "GRANODINE" "PERMADINE" "THERMOIL-GRANODINE"
	Phosphate Coating, to Protect Friction Surfaces	"THERMOIL-GRANODINE"
	Pickling with Inhibited Acids	"RODINE"
	Rust Prevention for Unpainted Iron	"PEROLINE"
	Rust Proofing	"PERMADINE" "THERMOIL-GRANODINE"
	Rust Removal—Brush, Dip, or Spray	"DEOXIDINE"
	Soldering Flux	"FLOSOL"
GALVANIZED IRON, ZINC, AND CADMIUM	*Cleaning*	"DURIDINE" "ACP RIDOLINES AND RIDOSOLS"
	Corrosion Proofing	"ZINODINE"
	Paint Bonding	"ZINODINE"
	Phosphate Coating, in Preparation for Painting	"LITHOFORM"
	Soldering Flux	"FLOSOL"
ALUMINUM	*Cleaning*	"DEOXIDINE" "DURIDINE" "ACP RIDOLINES AND RIDOSOLS"
	Preparation for Painting	"ALODINE" "DURIDINE" "DEOXIDINE"
	Protection from Corrosion	"ALODINE"

CHEMICALS ACP PROCESSES

WRITE FOR DESCRIPTIVE FOLDERS ON THE ABOVE CHEMICALS AND FOR INFORMATION ON YOUR OWN METAL PROTECTION PROBLEMS

CHEMICALS ACP PROCESSES

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the 7:3 mole ratio of tungstate to molybdate was selected to be used for additional work. This bath was prepared from 0.161 mole (53.1 gm.) sodium tungstate and 0.069 mole (14.2 gm.) sodium molybdate to give a total of 0.23 mole/liter to tungstate plus molybdate.

Citric acid is a necessary component of the plating system and functions as a complexing agent. Tests showed that an increase in citric acid concentration from 0.3 to 0.5 mole/liter produced a drop in current efficiency. Studies also showed that as the cobalt sulfate concentration of the bath increased, the percentage of tungsten in the deposit was unchanged, the percentage of molybdenum decreased, the percentage of cobalt increased, and the cathode current efficiency increased. Dr. Holt reported that additional work has shown that the following ternary alloys can be electroplated from the citrate type of plating solution: iron-tungsten-molybdenum; nickel-tungsten-molybdenum; cobalt-nickel-tungsten; iron-cobalt-tungsten; iron-nickel-tungsten; cobalt-nickel-molybdenum; iron-cobalt-molybdenum; iron-nickel-molybdenum; and iron-cobalt-nickel.

* * *

Take Advantage of Modern Finish Application Methods

SPRAY painting, as a modern industrial finishing method, has the advantages of speed and adaptability to many conditions. Dipping, tumbling, or centrifugal finishing is often used for small articles especially if large quantities are involved. Some finishing installations use a combination of spray finishing with conveyorized dipping, depending on the part. Electrostatic methods have contributed to economies of both spray and dip coating methods.

To secure large unit production at

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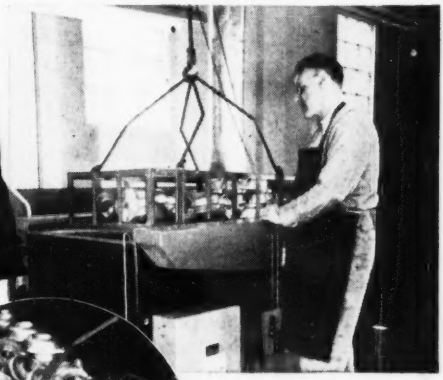
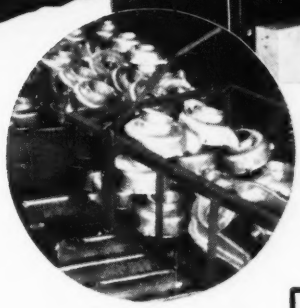
POWER TOOL MANUFACTURER CLEANS CASTINGS, STAMPINGS, MACHINED PARTS, FASTER AND MORE THOROUGHLY WITH A PHILLIPS DEGREASER





Skilsaw reports improved cleaning before painting and assembly.

Above: **Metal parts are thoroughly cleaned in Phillips high efficiency Model 60 degreaser. Inset shows condition of parts *after* degreasing.**

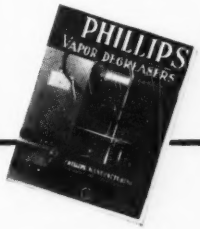
HERE is another case illustrating the high cleaning efficiency of Phillips degreasers. Skilsaw, Inc., Chicago, uses a Phillips Model 60 electric batch-type machine to clean both aluminum and iron castings, steel stampings, shafts and screw machine parts. These parts must be thoroughly cleaned before painting and assembly of the finished product. Among the types of soil removed are coolants, kerosene, drawing oils, and just plain shop dirt.

Skilsaw reports that the Phillips unit cleans their parts better, as well as 3 to 4 times faster than their former method. Thus production is speeded up and better control is assured over the quality of the finished product.

Check into the time and money you can save with Phillips Vapor Degreasing. Our representative will be glad to discuss your parts cleaning problem with you.

SEND FOR YOUR COPY OF THIS NEW BULLETIN

Describes and illustrates Phillips engineered metal cleaning equipment.



Phillips 3465 TOUHY AVENUE • CHICAGO 45, ILLINOIS

MANUFACTURING COMPANY

ENGINEERED METAL CLEANING EQUIPMENT

Fig. 2—Hot spray finishing unit produced by Binks Manufacturing Company.
(Photo courtesy Binks Manufacturing Co., Chicago 12, Ill.)

low cost and to insure continuity and uniformity of the coating applied, some manufacturers of metal products are employing completely automatic spray finishing equipment. One of the most important advances in finish application methods in recent years has been the successful development of the hot spraying process.

Figure 2 shows one type of hot spray unit.

Finishing Military Requirements

In discussing the finishing of Quartermaster Corps items before the Annual Convention, National Paint, Varnish and Lacquer Association, George J. Merritt, Quartermaster General's Office, Department of the Army, pointed out that these items may be broken down into two general classes: (1) Those of commercial nature wherein the durability requirements of the finish are much the same as the item would receive in an industrial, commercial, or home use. These items may be termed industrial items. (2) The other large class of quartermaster items are those which are of strictly military nature. Organic coatings, when required, are designed to meet the abuse of global transportation, storage, or use. Of all the variables involved, the most important for these items is durability.

According to Merritt, the finishing of industrial items is left pretty much to the discretion of the manufacturer who has the contract to produce and supply such an item. In case of such items the specifications state that the finishing shall be in accordance with good commercial practice as applied to the normal commercial items. On such items, Merritt pointed out that the use of lacquer applied by the hot lacquer process may be advantageous from the manufacturer's standpoint and consequently may allow him to submit a lower price bid. The coating requirements of Quartermaster Military items are designed to protect and/or camouflage that item during its life, no matter where stored, used or transported. Each individual item has the coating requirements based upon what is termed military requirements.

Specification MIL-L-11195 covers hot spray lacquer which includes six colors plus black and white. While this specification describes a lacquer in the lustreless range, the high performance is stated to be due to careful selection of inert pigments and pigment to binder ratio. This material was originally developed for ammunition and components but will probably be more widely used because of its good gasoline resistance. It is reported that this specification coating has been designated as a finish coat for army tanks in 1.0 mil thickness and conceivably may be

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More news about getting "a better start for your finish"

Soak-tank cleaning costs cut 50% with an amazing Pennsalt Cleaner

If you think the last word has been said on soak-tank cleaners, here's a straight-from-the-field case history that may change your mind:

The operators of a porcelain enameling plant in Illinois were having difficulty in removing stamping oils from parts to be enameled. The parts were cleaned in two steam-heated, air-agitated soak tanks with an alkaline cleaning compound in solution. The Pennsalt representative recommended that the company try Pennsalt Cleaner #39—with these results:

Now the operation requires 3123 lbs. of Cleaner #39 every three months. Before, it required 5162 lbs. of the former material for the same period—a saving of about 40% on poundage alone! The actual dollar saving is even greater because Pennsalt, a basic chemical producer, sells its cleaner at a lower cost per pound. But that's not all!

Now a tankful of Cleaner #39 lasts six weeks; the cleaner formerly used was exhausted after three or four weeks. And as for the quality of the job done—rejections due to poor cleaning have now dropped to an all-time low! In fact, the operators of the plant are so pleased with this 50% over-all saving, that they have, on their own initiative, persuaded a fellow manufacturer to switch to Pennsalt Cleaner #39!

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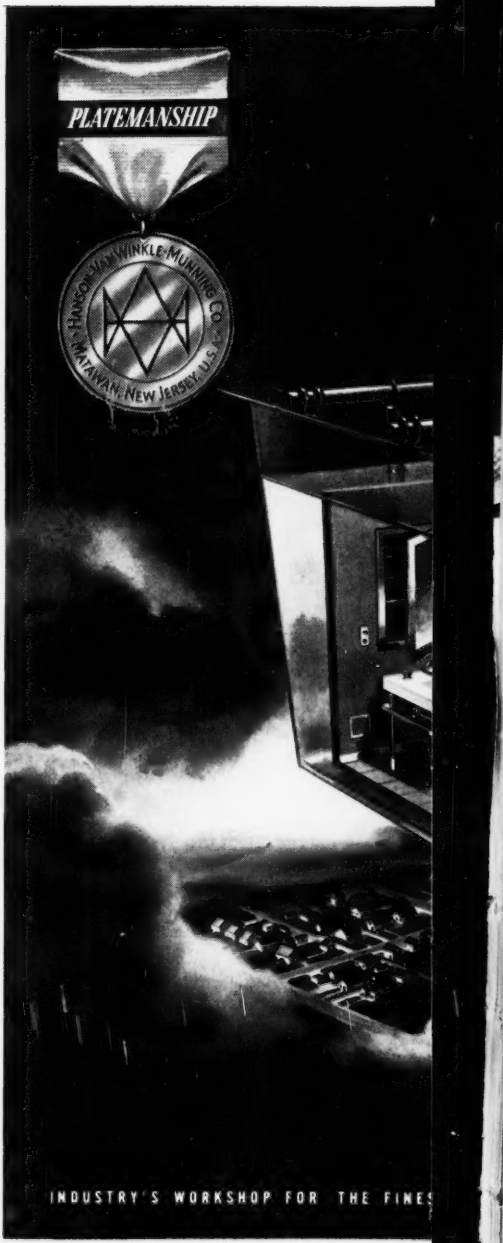

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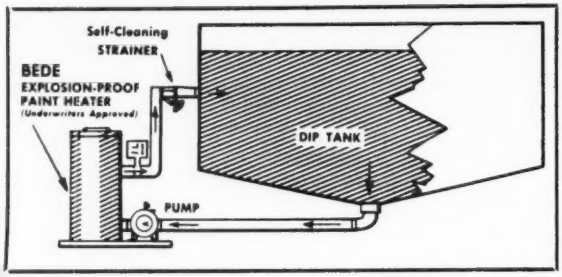


Fig. 3 — This Bede dip tank heating system maintains finish at correct temperature, provides circulation and retards settling. (*Illustration courtesy Bede Products, Inc., Cleveland 9, Ohio*)

considered for self-propelled guns, amphibious cargo carriers, busses and other ordnance equipment.

Requirements in respect to hot spray application of this material are as follows: atomization air pressure, 50 p.s.i. minimum; cold lacquer feed tank pressure, 10-15 p.s.i.; lacquer temperature at spray gun, 160 $\pm$ 5 deg. F.; distance from spray gun to work, 6 to 8 inches; lacquer flow rate at nozzle, 10 to 20 fluid ounces per minute; thermostatic setting on lacquer heating unit 175 deg. F. maximum.

Spray-Finishing Equipment Available For Many Requirements

Essentially, the spray-finishing apparatus is not necessarily big or complicated. The essential components have been described* by L. W. Lammiman, The DeVilbiss Company, Toledo. They consist of an air compressor to supply air power to the spray gun. An air transformer filters out dust and dirt, condenses oil and moisture, and regulates the flow of air. A paint container, either cup or tank, is needed to contain the material being sprayed and to meter it out to the spray gun, which is necessary to apply the material properly to the surface. This combination of equipment is available in all sizes, shapes, and degrees for many flexible finishing operations. A wide range of spray guns are available, including touch-up guns, small cup guns, medium production guns, standard production guns, and automatic guns.

In general, the equipment chosen should depend upon the requirements of the job. The size, coating material, type and area of the surface, as well as the production rate, all should be taken into consideration.

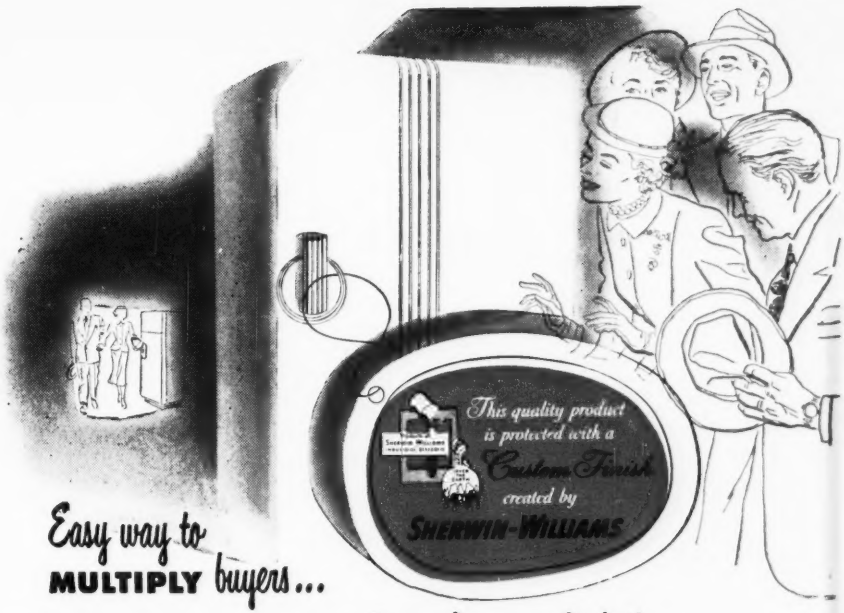
Automatic sprayers have proved to be economical setups which not only save time and material but which finish large quantities of work with a high degree of uniformity. Automatic spray finishing machines are used to coat a large variety of products such as refrigerators, venetian blinds, lamp shades, pipes, flat ware such as panels and multiple small parts.

Conveyorized dipping where the objects being finished move into and out of the dip tank on a conveyor at a steady rate has shown advantages in many finishing operations. Sometimes manufacturers use a combination of spray coating and dip coating depending on the type of metal part.

Figure 3 shows a setup for heating a dip tank using a commercial Bede Dip tank heater. In addition to maintaining coating material at correct temperature the dip tank heater provides constant circulation and retards settling by conventional flow.

Among the important developments in finish application methods is the use of an electrostatic field to insure maximum efficiency in the deposition of the

* L. W. Lammiman, "Spray Painting." *Paint and Varnish Technology* edited by Wm. von Fischer, Reinhold Publishing Corp., N. Y.



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coating material through the electrostatic spray process and electrostatic detearing which removes excess material from dipping or flow-coating. These processes, developed by the Harper J. Ransburg Co., Indianapolis, are based on the well known electrical principle that like charges repel and unlike charges attract. In general, parts to be coated are hung from or supported by a conveyor and are carried into the spray zone where the objects are surrounded by an electrostatic field. Coating material atomized into this field by automatic guns is attracted to the objects under the action of the field. The parts being finished thus collect their full coating as they move along the conveyor between the electrodes. Advantages are the efficient application of coating material in an automatic manner. Savings in finishing material is significant on irregularly shaped parts.

In production line applications of electrostatic detearing, parts coated by dipping are carried over the drain board which catches and returns to the tank the principle excess material. The parts then pass over a charged grid which causes a strongly attractive electrical force to be exerted on the grounded piece. This removes excess paint which has collected at drain-off points or edges and promotes a smooth coating on the dipped parts.

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* * *

Tin-Zinc Alloy Electroplate Protects Steel In Contact With Aluminum

IN a recent report from the Tin Research Institute the results are given on tests conducted by the Fulmer Research Institute to determine the most suitable protective treatment for the steel bolts normally used in contact with aluminum. The steel bolts used in the tests were protected as follows: sherardized, zinc plated, black oxide finish, cadmium, Parkerized, tin-zinc alloy plate. Unprotected steel and solid brass were included for comparison. Three bolts of each type were fixed to a piece of aluminum plate, and one set of specimens was exposed for 26 weeks to each of the following corroding conditions: 3 per cent salt spray; humid sulfur dioxide atmosphere; marine atmosphere and industrial atmosphere.

The results of the tests showed that in all cases the tin-zinc alloy coatings not only protected the steel bolts but gave rise to a minimum amount of corrosion of the aluminum plates. Also, the bolts were easy to remove after the tests. Zinc coatings, reportedly, gave the next best all-round performance and although a good deal of corrosion product was formed on the zinc, the steel was not attacked and corrosion of the aluminum was slight. In

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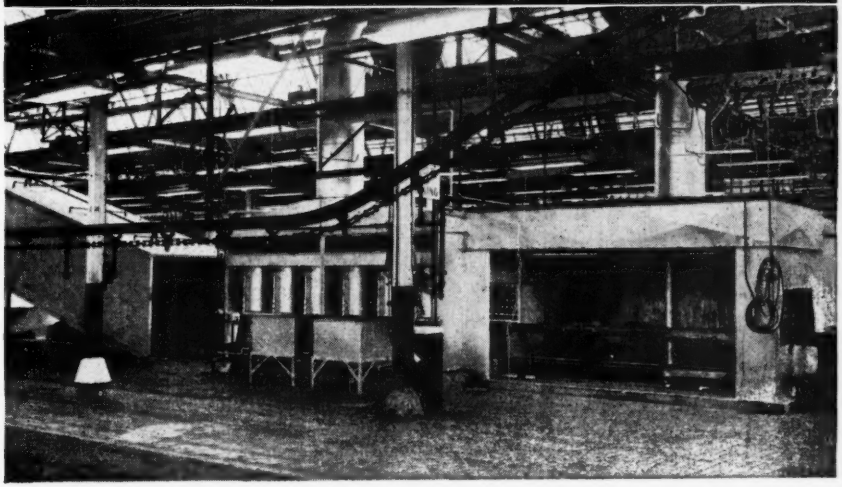

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general, the salt spray test proved to be more severe than the sulfur dioxide atmosphere test. The results of the field tests, although less fully developed, confirmed the relative merits of the finishes as found in the laboratory tests.

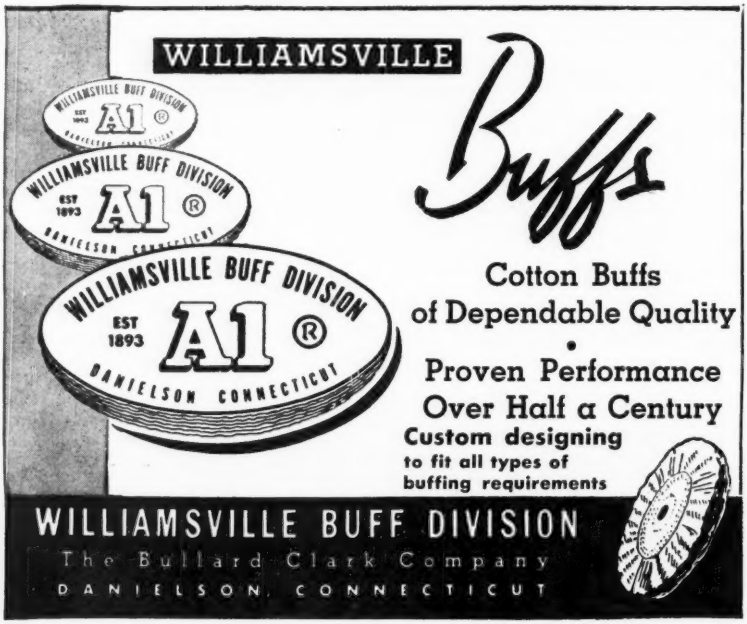
* * *

Nickel Dip In Porcelain Enameling

STUDIES conducted recently at The Pennsylvania State College have shown that nickel applied to sheet steel as a nickel flash prior to porcelain enameling endures in the surface through several de-enamelings and re-enamelings. The attendant improvement in the enameling behavior of the steel is similarly persistent. The experimental work, conducted by J. H. Keeler, P. K. Chu, and H. M. Davis and reported in the "Journal of the American Ceramic Society" produced evidence to the effect that while the fired enamel is cooling, nickel oxide at the interface is reduced by hydrogen issuing from the steel, forming water which enters the enamel. This diminishes the hydrogen available for defect formation.

It is widely accepted that nickel oxide and cobalt oxide in porcelain enamel on a ferrous metal contribute much to the adherence of the enamel to the iron. In most commercial ground coat enamels the sum of both oxides make up about 1 per cent of the composition of the enamel. A major technical drawback in the use of cobalt and nickel oxides is that they color an enamel. In the development of the single coat white enamels it has been necessary to develop substitutes for these oxides.

The nickel-dipping process has, in a measure, compensated for the adherence loss, while largely avoiding the



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problem of coloring the enamel, because the nickel is added only to the inter-facial area where it is partially oxidized during the firing operation. No data has been reported which shows the difference between the effects of nickel and of cobalt at the interface. Experiments conducted to determine this point showed that a nickel dip, which deposits metallic nickel on the surface of the iron, will produce enameling results that are not derived from a similar coating of cobalt. In this function, a cobalt layer was found to be comparatively ineffective.

Because of the shortage of nickel it is important that enamelers take precautions to conserve nickel salts. A recent report in "Ceramic Industry" suggests that the bath life of the nickel dip may be lengthened by converting the collodial iron created in the dipping operation to particles of larger size that can be removed by filtration. The addition of a small amount of an oxidizing agent to the bath is the best way to make the filtration effective. Small quantities of potassium or sodium permanganate, persulfate, hydrogen peroxide, or potassium chromate are effective. Hydrogen peroxide is a good reagent, if it is desired to avoid buildup of sodium salts. One plant that uses this method has obtained good results with sodium persulfate. It is not necessary to stop the production line to carry out the treatment. Another method ("Better Enameling," Vol. 21, No. 12) suggests batch treatment of the nickel dip bath by raising the temperature and alkalinity of the solution, and bubbling air through it for a period of 4 to 6 hours. Filtration is carried out and the bath is readjusted to the preferred range for production use.

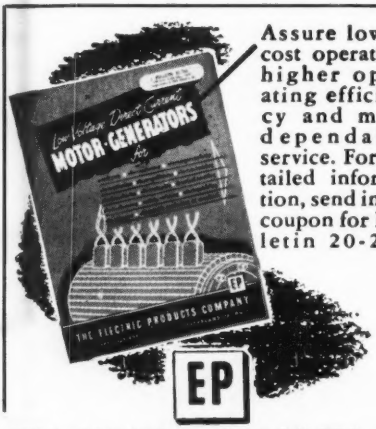
* * *

Hot Spray Lacquer Schedule for Finishing Armored Tank

A test on the application of hot spray lacquer confirming to the new military specification MIL-L-11195 was conducted a short time ago at the Detroit Tank Arsenal. The demonstration was the means by which the Ordnance Department introduced a recommended paint system with lacquer specifications formulated by the Automotive Paint and Chemical Laboratory at the Aberdeen Proving Grounds. Those in attendance witnessed the painting of an M46 (General Patton) Tank hull utilizing the schedules outlined below after the hull had been cleaned to the bare metal.

The schedule of operations used in finishing interior surfaces of the tank hull was as follows:

STEP I — One cold spray coat of Primer, Wash, Specification MIL-P-15328. Wash primer was reduced 3-1 with Thinner, Lacquer, Specification TT-T-266; approximately ¾ gallon of reduced wash primer was used. The



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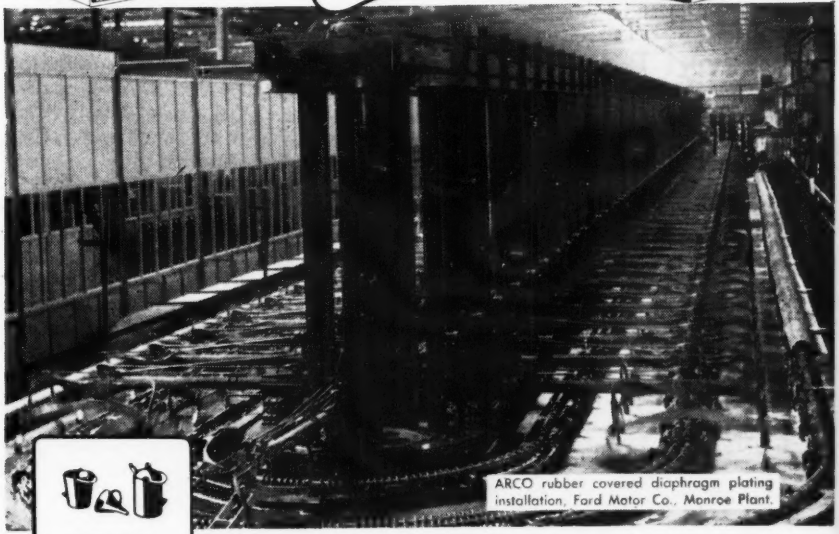

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coating thickness was approximately 0.2 mil with a permissible recoat time of approximately five minutes.

STEP II — One cold spray coat of Primer, Lacquer, Red Oxide, Specification number pending. The lacquer primer was reduced 3-1 with Thinner, Lacquer, Specification TT-T-266. Approximately 1⅛ gallon of reduced lacquer primer was used. The coating thickness was 0.60 to 0.75 mil with a permissible recoat time of approximately twelve minutes.

STEP III — One cold spray coat of Surfacer; Lacquer, Specification MIL-S-10181. The lacquer surfacer was reduced 3-1 with Thinner, Lacquer, Specification TT-T-266. Approximately two gallons of reduced lacquer surfacer was used. The coating thickness was approximately ¾ mil with a permissible recoat time of approximately fifteen minutes.

STEP IV — One hot spray coat of Lacquer, Lusterless, White Specification MIL-L-11195. There was no reduction of the 1½ gallons of packaged material used. The coating thickness was in excess of 1.0 mil and dried to handle in approximately ten minutes. The use of cold spray white lacquer in place of hot spray white lacquer would be acceptable if preceeded by Steps 1, 2, and 3.

In painting exterior surfaces of the hull the following schedule of operations was employed:

STEP I — One cold spray coat of wash primer identical with that used in Step I for interior surfaces.

STEP II — One cold spray of lacquer primer identical with that used in Step II for interior surfaces.

STEP III — One hot spray coat of lacquer, lusterless olive drab identical with that used in Step IV for interior surfaces, with the exception of the difference in color.

According to Hercules Powder Company, the use of lacquer systems such as the above will be optional to the cur-

treat

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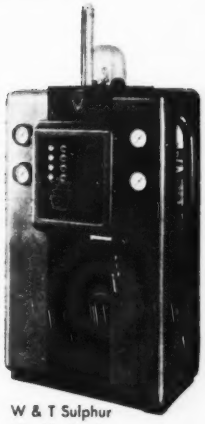

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Table I

TIN-ZINC ALLOY PLATING BATH FOR STILL TANKS AND AUTOMATICS

CONSTITUENT	FOR MAKE-UP oz./gal.	CONTROL LIMITS (by analysis) oz./gal.
Potassium stannate	16.0	
(Tin equivalent)	6.0	5.0-6.0
Zinc cyanide	1.2	
(Zinc equivalent)	0.67	0.5-0.8
Potassium cyanide	2.8	5.0-7.0
Free potassium hydroxide	0.87	0.65-1.1
Temperature	150 deg. F.	
Cathode current density	10 to 75 amp./sq.ft.	

TIN-ZINC ALLOY PLATING BATH FOR BARREL PLATING

CONSTITUENT	FOR MAKE-UP oz./gal.	CONTROL LIMITS oz./gal.
Potassium stannate	12.7	
(Tin equivalent)	4.7	4.3-5.3
Zinc cyanide	1.8	
(Zinc equivalent)	1.0	0.9-1.2
Potassium cyanide	2.0	5.0-6.7
Free potassium hydroxide	1.3	1.1-1.5

(Technical Data Sheet No. 107—Metal and Thermit Corp., N. Y.)

rently authorized enamels on tank automotive materials. However, in each case it will be necessary to obtain specific authorization from the Materials Branch, Development and Engineering Department, Detroit Arsenal, Center Line, Michigan. In addition, a careful integration must be made to prevent the use of lacquers by manufacturers receiving enamel system painted parts from other sources if such parts receive a subsequent finish by a lacquer-using manufacturer.

* * *

Tin Alloy Plating

RECENT developments in the tin alloy plating processes were discussed at the alloy plating symposium held during the 100th Electrochemical Society Meeting. F. A. Lowenheim, Metal and Thermit Corporation, reported on properties of tin-zinc alloy deposits and gave bath formulations of the potassium type suitable for shop use. Lowenheim pointed out that the 80-20 tin-zinc alloy deposit has properties which not only suggest it as a replacement for cadmium, but make it a satisfactory finish for many applications. Outstanding properties of the alloy deposit are good corrosion resistance and ease of solderability.

According to Metal and Thermit Corporation data, the greatest interest in the new alloy plating process has been evidenced by the electrical and the electronics industries, where the combination of corrosion resistance and solderability are particularly desirable. It is reported to out-perform zinc in the salt spray test, and in particular does not form bulky, white cor-

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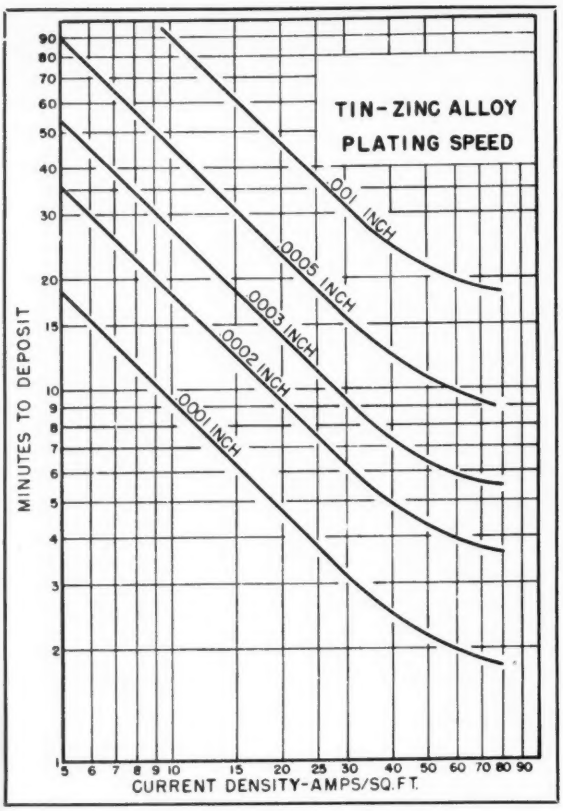

Fig. 4—Plating speed of tin-zinc alloys. *(Illustration courtesy Metal and Thermit Corp., New York, N. Y.)*

Figure 4 shows the plating speed of tin-zinc alloys. Anodes of the same composition as the deposit are used in the process: 80 per cent tin, 20 per cent zinc. In general, anode area should exceed work area in a ratio of approximately 2:1, since permissible cathode current densities are higher than anode current densities. As in plating from the alkaline stannate tin bath, the anodes must be filmed for satisfactory operation. Conventional cleaning cycles are satisfactory for tin-zinc alloy plating, just as in general plating practice.

rosion products typical of zinc. Tests have shown that the throwing power and covering power of the alloy plating process are good.

The bath which was recommended for producing the tin-zinc alloy plate is basically the potassium stannate tin bath plus a small amount of zinc cyanide and larger proportions of potassium cyanide. The process is adaptable to most types of plating equipment-still tanks, automatics, and barrels—without the need for any unusual provisions. Two formulations have been suggested, one for still tanks and automatics and the other for barrels.

Tin-Nickel Alloy Plating

The effect of variables on the composition and properties of tin-nickel alloys plated from a bath containing stannous chloride, nickel chloride, sodium fluoride and ammonium bifluoride was presented by J. W. Cuthbertson and N. Parkinson, Tin Research Institute. The tin-nickel alloy plate, which contains about 65 per cent tin and 35 per cent nickel, has been reported to remain permanently bright when exposed to the atmosphere or to many other liquids and sprays that corrode other metals. A typical bath recommended by the Tin Research Institute for tin-nickel alloy plating

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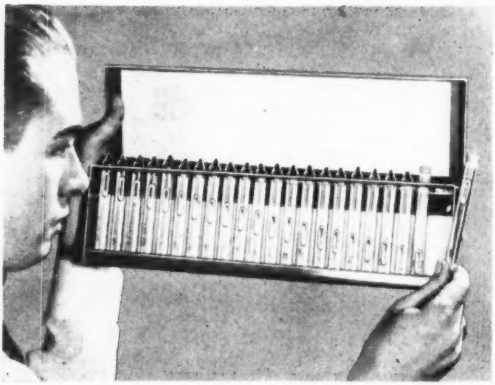


Fig. 5—The Gardner Varnish Series Bubble Viscometer is useful for rapid viscosity measurements. (*Photo courtesy Henry A. Gardner Laboratory, Inc., Bethesda 14, Md.*)

has the following composition:

TIN-NICKEL ALLOY PLATING BATH COMPOSITION FOR MAKE-UP

CONSTITUENT	gm./L.
Stannous chloride	27
Nickel chloride	300
Sodium fluoride	28
Ammonium bifluoride	35
Temperature	150 deg. F.
Cathode current density	about 25 amp./sq. ft.

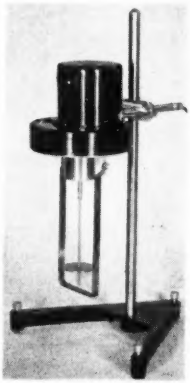
The results of corrosion tests reported on the tin-nickel deposit by the Tin Research Institute have shown that the alloy plate is resistant to a wide variety of corrosive agents, and have indicated it to be in the same class as chromium plate. The alloy plate is electrochemically noble to steel, with a potential close to copper. On steel an undercoating of about 0.0005 inch copper, followed by the tin-nickel alloy plate, has been found to provide good corrosion resistance.

* * *

Lacquer Viscosity Affects Application Properties and Quality of Finish

BRUSHING, spraying and dipping properties of organic coatings are important because they influence the labor required in, and the speed of, applying coatings. The consistencies of most clear coatings as determined by viscometers indicate their application properties. One of the most widely use viscosity measuring devices is the one in which the speed of a rising bubble in a glass tube is compared to that of standards in similar tubes, illustrated in Fig. 5. On the other hand, measurements in simple viscometers may not give the whole story on application properties of pigmented finishes.

Fig. 6 — The Brookfield Synchro-Lectric Viscometer. (*Photo courtesy Henry A. Gardner Laboratory, Inc., Bethesda 14, Md.*)



One method for evaluating the consistency of pigmented coatings is to determine the speed at which a perforated piston descends through a cylinder filled with the paint. This is known as the Mobilometer method. Another method measures the speed of a paddle driven through the paint, using the Krebs-Stormer Viscometer. Figure 6 shows the Brookfield Synchro-Lectric Viscometer. In this instrument the torque on a spindle rotating at a constant speed in the finishing

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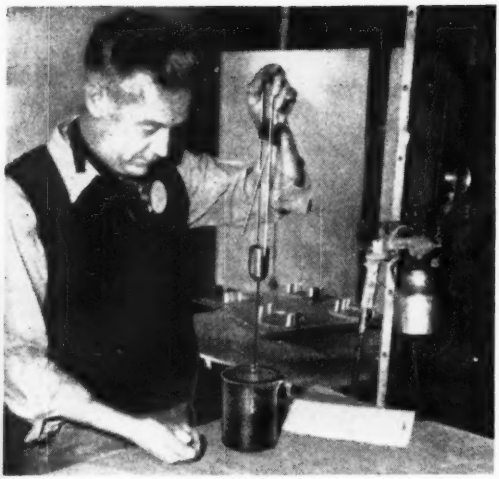

Fig. 7—The G-E Zahn Viscometer being used to measure paint viscosity at the spray booth.

material is measured by a calibrated spring.

A third method, which is also widely used for clear finishing materials, measures the speed at which the paint flows through a hole in the bottom of a cup, as illustrated in Figure 7.

The solids content of a lacquer is generally limited by the maximum viscosity that is permissible for the intended application. Of the solids used in lacquers, nitrocellulose has the most marked effect on viscosity as its concentration is increased. For this reason, solvents that produce solutions of the lowest viscosity for a given concentration of nitrocellulose may be a definite advantage. Some of these advantages have recently been brought out by data made available* by Shell Chemical Corporation.

First of all, solvents contributing low viscosity are required in smaller quantities when blending to a given viscosity. Secondly, with the current trend toward high solids lacquers, these solvents are particularly advantageous in that higher solids concentrations can be obtained in a workable viscosity range. Thus, it is frequently possible to reduce the number of lacquer coats necessary to give a desired film thickness. This results in lower application costs. Another point is that solvents which give low viscosity nitrocellulose solutions permit the formulation of lacquers in a workable range which contain a greater quantity of diluent. Although choice of active solvent is one of the most important single considerations in obtaining low viscosity lacquers other factors such as nitrocellulose grade, type of resin and concentration and nature of diluent and concentration influence solution viscosity.

Data, listing viscosities of several different nitrocellulose solutions at various concentrations of RS½ sec. nitrocellulose, show that ketones, in general, give nitrocellulose solutions of lower viscosity than do solutions of esters of similar evaporation rate. For example, at the same nitrocellulose concentration, methyl ethyl ketone gives lower viscosity solutions than does commercial ethyl acetate.

Viscosity is also a function of the nitrocellulose type. In general, the higher the viscosity of the nitrocellulose used in a lacquer, the greater may be the toughness, flexibility and cold check resistance of the resulting films. Therefore, in many applications, it is preferable to use as high a viscosity type of nitrocellulose as possible, commensurate with a desirable solution viscosity and solids content.

* Shell Chemical Corp., Technical Publication SC: 50-2—Methyl Ethyl Ketone.

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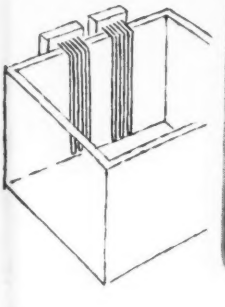

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The type and concentration of resin employed in a lacquer formula affect viscosity. As a general rule, resin solutions are considerably less viscous than nitrocellulose solutions. However, lacquers usually consist of mixtures of nitrocellulose and resins as well as other materials, and the resulting viscosity of lacquer solutions, in addition to being influenced by the viscosity grade of nitrocellulose, will depend on the type of resin and its ratio to nitrocellulose.

Concerning the ratio of nitrocellulose to resin, J. R. Yeager, Hercules Powder Company, has pointed out* that the general tendency is for higher proportions of resin relative to nitrocellulose to give softer films with resultant better cold-check resistance, but with excessive dirt pickup and poor water resistance. A ratio of 2 parts resin to 1 part nitrocellulose appears to be the best combination for all properties. The choice of resins will depend on the properties desired in the lacquer film. The non-drying type of alkyd appears to be one of the most generally useful ones. The addition of hard resins, for example, maleic modified ester gums, increases the hardness but adversely affects cold check outdoor exposure, and resistance to humidity. Small additions of urea or melamine resins increase the hardness without any marked reduction in resistance to cold check, and without affecting outdoor exposure adversely. In all cases the solvent mixture should be chosen so as to give the best spraying and dissolving properties.

One method of increasing the solids content of a lacquer without adversely affecting viscosity to too great an extent is by increasing the resin-to-nitrocelulose ratio. Non-drying alkyd

* Recent developments in nitrocellulose Lacquers"—*Paint and Varnish Technology*. Edited by Wm. Von Fisher, p. 197—Reinhold Publishing Corp., N. Y.

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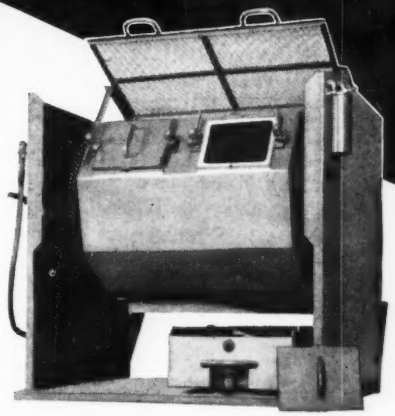

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resins are employed in nitrocellulose lacquers designed for outdoor durability and are widely used in metal lacquers used for automobile finishes. These resins, in combination with nitrocellulose, are soluble over a wide range of possible solvent compositions. In general, ketone solvent systems provide somewhat greater tolerance to diluents such as toluene than does the ester system. Also, the solvency of the ketone system is more susceptible to activation by alcohol than is the ester system.

Viscosity Affects Application Properties

The smoothness of lacquer films applied by spray is influenced by a number of factors including the viscosity of the finishing material. Too high viscosity may cause bad flow partly because of the poorer atomization of the more viscous lacquers by the spray gun, and also because lacquers of high viscosity flow less readily. They reach the so-called "set-up" condition at an earlier point in the evaporation schedule and thus act like the solvents have been evaporated from the film in a shorter period of time.

Some of the undesirable effects of high viscosity can be counteracted to some extent, at least, by a reduction in the speed of evaporation of the solvent mixtures. The poorer atomization can be corrected somewhat by having the film remain liquid for a longer period of time. Thus, it can be seen that, in general, lacquers containing higher proportions of the slow-evaporating solvents can be sprayed at higher viscosities than those containing faster-evaporating solvent mixtures. In the hot lacquer process, the lacquer is heated and is sprayed while hot.

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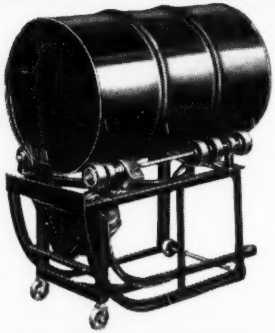
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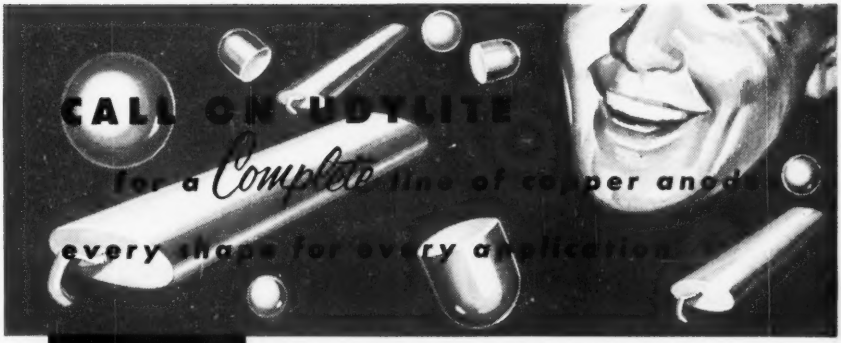

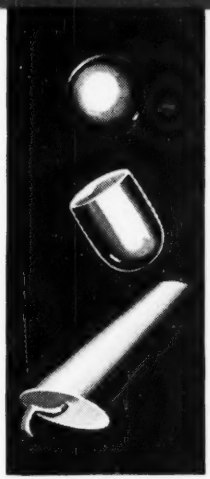

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PIONEER OF A BETTER WAY IN PLATING

NEWS of the Industry

COMPANIES

Nathaniel Hall, consulting engineer, has announced the formation of **Nathaniel Hall Company**, which will specialize in the fields of metal finishing, electrodeposition and allied processes. Office and laboratory are located at 239 Waverly Ave., Brooklyn 5, New York.

At the Protective Coatings Exhibit, sponsored by Mr. Joseph Mazia, consulting Engineer, at the Statler Hotel, Washington, D. C., several members of the **AMERICAN CHEMICAL PAINT CO.** were in attendance.

Main theme of the Exhibit was the application of protective coatings for steel, zinc, and aluminum to military products to increase their durability under service conditions. Purpose of the displays was educational, to show Government personnel how protective coating techniques, now standard practice in civilian production, can be effectively adapted to military production.

Among other companies attending the exhibit were Stoner Mudge, Inc., (Specification Paint Finishes); and Orchard Brothers, Inc., (metal specialties).

ASTAR TUMBLING MACHINE CORP., 36 Clinton Street, Yonkers 2, New York, will celebrate its first anniversary in the business field. Mr. Emil Astarita, president of the corporation, was formerly with Tumb-L-Matic Inc., and Lupomatic Tumbling Machine Corporation. He has had over 15 years of experience in the tumbling field, dealing with equipment and compounds for cutting and polishing.

ELECTROCHEMICAL INDUSTRIES, INC., Worcester, Mass., according to an announcement by Dr. Harold Narcus, president and technical director, has been designated a manufacturers agent by the Bersworth Chemical Co., Framingham, Mass., to handle the sales and distribution of its complexing and chelating agents known as Versenes. In both pow-

Persons at the Protective Coating Exhibit include (l. to r.): Mr. William B. Boyer, Asst. Sales Manager; Mr. James Thirsk, Technical Service Department; a visitor; and (standing), Mr. F. P. Spruance, Vice President in Charge of Sales.

der and solution form, these developed organic compounds are finding numerous applications in water softening, removal of impurities from plating solutions such as nickel, copper, zinc, silver, and gold baths, and for the inactivation of troublesome metallic impurities in other process solutions.

In addition to sales and distribution, Electrochemical Industries offers technical assistance in properly applying these compounds.

NEW POSITIONS

The Hanson-Van Winkle-Munning Company announces the retirement of **ROBERT J. MALKMUS** after more than 29 years as purchasing agent.

Robert J. Malkmus

Malkmus's association with the electroplating industry is one of the longest on record. It dates back to 1900 when he started with the Eddy Electric Manufacturing Company, manufacturers of low-voltage plating generators.

From 1905 until 1923 he held posts with other companies when, in the latter year, he became purchasing agent for A. P. Munning & Company. When this concern was combined with the Hanson & Van Winkle Company in 1927, Mr. Malkmus was elevated to the same post in the new organization, The Hanson-Van Winkle-Munning Company.

Since 1919, Mr. Malkmus has been a member of the Purchasing Agents Association of New York City and he is currently serving as Vice President and Director of The Matawan Bank, Matawan, N. J.

The appointments of several sales representatives have been announced by **AJAX ELECTRIC CO.**, Philadelphia, Pa. The Samson Sales Co., San Francisco, will handle Nevada and the Northern half of California; Richards-Conant, Denver, will cover Wyoming, Colorado, Utah, Arizona and New Mexico; and W. E. Hartley, Seattle, will handle Washington, Oregon, Montana, and Idaho. In the Northeast, the territory of long-time Ajax representative Joseph M. Halloran, has been extended to include all of New England.

HOMER J. HUMBERT, recently joined the staff of the Porcelain Enamel Institute as administrative assistant. According to John C. Oliver, secretary of the Institute, Mr. Humbert's duties which will include PEI committee activities and industry contact work, will enable the Institute to broaden its services to both members and the industry as a whole. Mr. Humbert has worked in the advertising and public relations field since 1945.

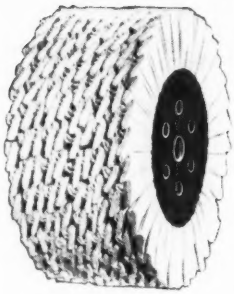
Homer J. Humbert

DR. GUY C. GIVEN, who became well known to the paint industry when he managed the business phases of Du Pont's "Duco" lacquer licensing program, retired recently after 26 years with the company.

Dr. Given left a position as associate professor of chemistry at the Pennsylvania State College to join the Atlas Powder Company in 1917. He became associated with Du Pont in 1925 and supervised the "Duco" licensing program from the early 1930's until the expiration of patents in 1944.

EDMUND JENNINGS and **PHILLIP S. WEXLER** were recently appointed to the engineering department of Rapid Electric Co., New York City. Mr. Jennings, formerly associated with Consolidated Diesel Electric Company, will supervise the mechanical design of all new Rapid products.

Mr. Wexler will apply his knowledge of electric power equipment to the elec-



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Thomas J. Menzel

The Hanson-Van Winkle - Munning Company, Matawan, N. J., announces the appointment of **THOMAS J. MENZEL** to the position of plating chemist. In his new position he will be responsible for all experimental and process plating in H-VW-M's new plating laboratory.

Menzel has a B. S. degree from Hudson College of St. Peters College, Jersey City, and has completed special courses at New York University.

His work in the electrochemical field began when he joined the Hanson-Van Winkle-Munning Company in 1943 as a chemist, later becoming analytical chemist.

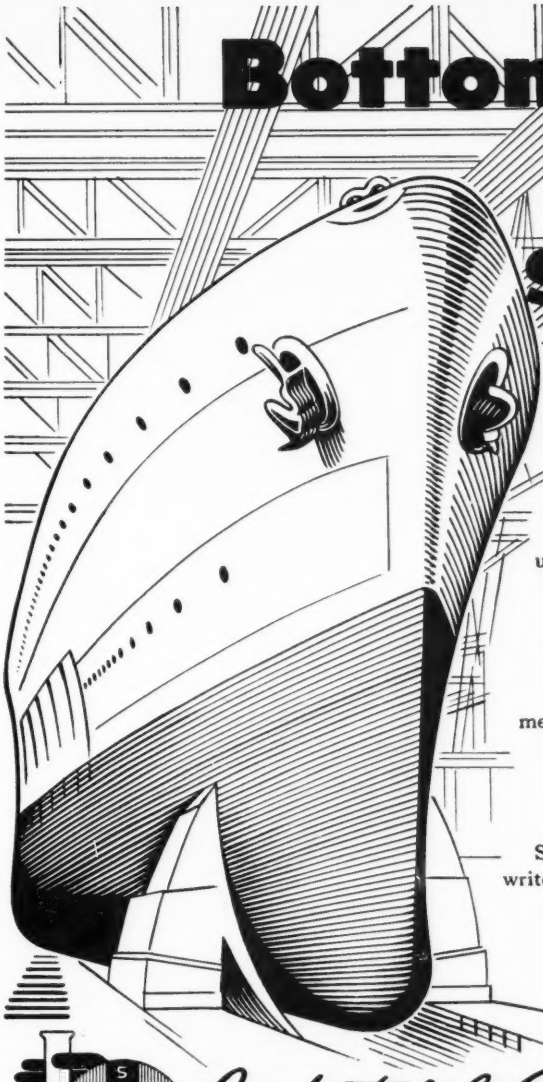
The DuPont Company's Finishes Division announces the appointment of **JOHN T. GEOGHEGAN** as industrial sales representative in the area comprising northwestern Tennessee, western North Carolina and northern South Carolina. Mr. Geoghegan replaces **W. I. KYLE** who has been promoted to industrial sales supervisor in Chicago.

Mr. Geoghegan will make his headquarters in Asheville, N. C. A graduate of North Carolina State College, he has served in various laboratory, production and sales capacities in the DuPont Finishes Division for the past 21 years.

Pennsylvania Salt Manufacturing Company has announced the appointments of **ARNOLD E. BLITZ** as sales supervisor in the ordnance field and **HUBERT A. DesMARAIS**, as general sales manager of Pennsalt of Washington.

Mr. Blitz joined Pennsalt as a sales-service representative last year. In his

Bottoms up! for Stantite



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new position, he will supervise the coordination of the company's sales and service with ordnance contractors and will act as liaison between the company and the government on this important phase of the mobilization effort. Mr. Blitz attended West Chester State Teachers College and is a member of the American Ordnance Association.

Mr. DesMarais, formerly Pacific Coast sales manager for the General Dyestuff Corporation, will locate at Pennsalt of Washington's central office in Tacoma. Well known in chemical and industrial fields in the West, Mr. DesMarais is a member of the American Pulp and Paper Industry, and of the American Association of Textile Chemists and Colorists. He is a graduate of Dartmouth College.

The appointment of **ARTHUR H. BURT** as director of sales for The Sherwin-Williams Company has been announced by Arthur W. Steudel, president.

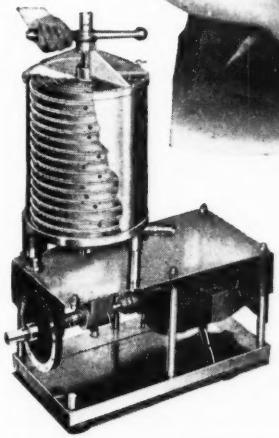
Mr. Burt has spent his entire business career with Sherwin-Williams, starting in the advertising department and progressing into practically every phase of the company's sales activities. Since 1946 he has been director of the North Central Sales Region with headquarters in Cleveland.

HARRY N. WALKER was named vice president in charge of procurement at a recent meeting of the board of directors of American-Marietta Company, Chicago. Mr. Walker joined the company on September 1, 1948, as director of purchases.

Hooker Electrochemical Company has announced the appointment of **CHARLES A. STRACK** to head research and testing work in its new Virgo Salt laboratory at Niagara Falls, N. Y. The new laboratory has just been completed and will be used for research and development work in various formulations for metal cleaning compounds. The facilities of the laboratory will also be available for testing and demonstration work for customers.

RANSON COOPER, JR., has been appointed manager of the nickel sales department and **H. D. TIETZ** manager of

guard against Rejects



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the Inco nickel alloys department of the International Nickel Company, Inc., according to an announcement by Dr. Paul D. Merica, president.

Mr. Cooper was graduated from Syracuse University in 1912 and became associated with the steel industry. He joined International Nickel in 1929 and has been assistant sales manager of the nickel sales department for several years.

Mr. Tietz joined the company in 1931 as a salesman and in 1939 was appointed administrative assistant to the sales manager of the Inco nickel alloys department. He has been assistant to the manager of this department since 1941.

A. SCHUBERT KLOSS, manager of production of the Naval Stores Department of Hercules Powder Company, retired on July 31. He has been associated with the department's central offices in Wilmington, Del., since 1939.

Prior to that, he served for 19 years as manager of a naval stores plant in Brunswick, Ga., manufacturing rosin, turpentine, pine oil, and chemicals derived from them.

FRANK W. VOLK, named manager of production with Mr. Kloss earlier this year, has assumed full responsibility for that post. Before transferring to Wilmington in January, Mr. Volk was superintendent of the naval stores plant at Hattiesburg, Mississippi.

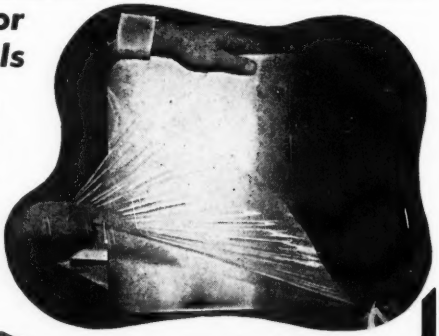
DR. DODD S. CARR is now associated with Bart Products, Inc., of Belleville, N. J., as assistant director of electrochemical development. He is in charge of all chemical and electrochemical phases of the electroforming operations of the company and will work on the development of new plating processes and techinques.

Dr. Carr received his doctorate in chemical engineering from The John Hopkins University and was formerly connected with the International Nickel Company Research Laboratory.

GEORGE T. COLLINS has been elected assistant to the president of the Pennsylvania Salt Manufacturing Company, it has been announced by George B. Beitzel, president.

A Strippable Plastic for the Protection of Metals

Striplastic is a protective plastic applied by spraying, dipping or rolling. It is used on stainless steels, high polished metal sheets, sheets in cold working or drawing, tools, dies and parts, and on sheets or metal parts before packaging. It protects against scratching and abrasion, and against rust. Also available as a booth coat protection.



THE STRIPLASTIC COMPANY
10828 QUEBEC AVE.
CLEVELAND 6, OHIO

Among many advantages, it is nontoxic, possesses great tensile strength and is easily stripped off in one piece. Write for complete information on this new strippable plastic.

Start Clean...
Stay Clean!

Sally spent too much time pushing that mop around to risk having dirty paws track up her floor . . . and no plater can afford to risk clean metal in a bath of questionable purity.

Red Label Darco S-51 adsorbs impurities that cause trouble in plating baths . . . takes them out before they can be deposited on the freshly cleaned surface of your work. It helps you save on scarce metals and do a better job with thinner deposits.

With clean metal . . . keep the bath clean

Red Label Darco S-51 is specially treated for use in plating — the only carbon that meets the benzol-mercury test! It's easy to handle . . . easy to wet . . . easy to make into a slurry. Place your order for Red Label Darco S-51 today. Nearly all suppliers carry Darco in stock, so don't accept substitutes.

Send for reprints of "Filter out your plating rejects."

DARCO DEPARTMENT
ATLAS POWDER COMPANY
Darco General Sales Offices
60 East 42nd Street, New York 17, N. Y.

KEEP SPRAY BOOTHS SAFER FROM FIRE!

WITH NON-INFLAMMABLE

BOOTHCOTE #4

FOR DRY WALL BOOTHS AND THE NEW

BOOTHCOTE #5 FOR WATER WASH BOOTHS

KLEENCOTE WATER WASH COMPOUND

Makes frequent cleaning easy. Pre-mixed, ready to use, safe to store. Saves time, labor, no flaking off. Spray or brush on clean booth. When desired, operator peels off overspray in sheets.

Advocated by insurance companies.

Money-back trial offer: 5 gals. $6.25

HYGRADE'S STERLING CREME

protects hands and arms from paint, grease, ink, etc. penetrating skin. Soil washes off easily without harsh solvents or cleaners.

40 lb. pail $12.

HYGRADE'S STERLING CLEANER

(WATERLESS HAND CLEANER)

dissolves grease, grime, fresh paint, tar, printers' ink, shellac, mastic cement, etc. without water. 40 lb. pail **$9.00.** ***All prices f.o.b. Buffalo.***

HYGRADE

FOOD PRODUCTS CORP.

Industrial Div., 18 Stetson St., Buffalo 6, N. Y.

Previously Mr. Collins was manager of market research and was engaged on special assignments having to do with long range company planning. He graduated from Villanova College in 1937 and joined the market research department of Pennsalt in 1943. He was named assistant manager of the department in 1945 and manager in 1946.

Mr. Collins is a member of the American Chemical Society, the Chemical Market Research Association, the American Marketing Association, the Chemists Club of New York, the Armed Forces Chemical Association and the American Ordnance Association.

STANLEY C. JOHNSON has been appointed chief abrasive inspector for Norton Co., Worcester, Mass., replacing **HARRY O. ANDERSON** who recently retired after 51 years with the company.

Mr. Johnson joined Norton Company in 1947 as a member of the manufacturing training course, and worked for nearly a year in each of the Abrasive Inspection, Manufacturing Control, and Grading Departments before becoming assistant to chief abrasive inspector in 1950.

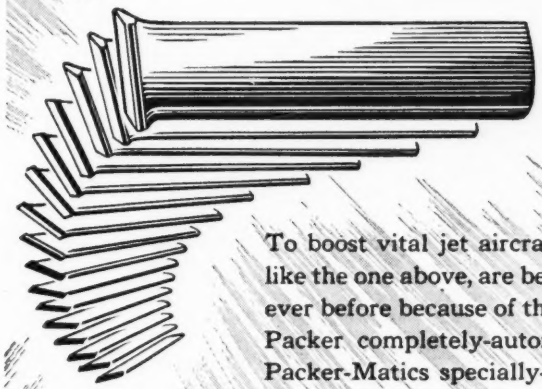
Mr. Anderson began his long association with Norton in 1901, in the chemical laboratory. Appointed chief chemist in 1912, he moved over to the polishing laboratory in 1918, and was made chief grain inspector for the Abrasive Division in 1920—the position he has held for the past 32 years.

The appointment of **DR. C. MANNING DAVIS** as head of the Analytical Section of the Research Laboratory of The International Nickel Company at Bayonne, New Jersey, was announced by N. B. Pilling, Director of the Research Laboratory.

Dr. Davis was in charge of The Elgin Watch Co. Fellowship at the Mellon Institute for Industrial Research at Pittsburgh from November, 1947, until July 1, where his activities included pilot plant operation, organic synthesis and organic analysis.

He has been Chairman of the Analytical Division of the Pittsburgh Section of the American Chemical Society and was Chairman of the Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy in 1951.

Jet blade production increased



by PACKER-MATIC MACHINES

To boost vital jet aircraft production jet blades like the one above, are being produced faster than ever before because of the speed and efficiency of Packer completely-automatic buffing machines. Packer-Matics specially-designed to do this one job are finishing at a high rate of production, to exacting specifications, without a single finishing reject. Packer machines are also hard at work buffing, grinding, or de-burring reciprocating engine parts for planes, tanks, and vehicles, casings for shells, and many more items essential to defense. If higher finishing room production can help you, whatever you make, write today for more information about the versatility of continuous, indexing, or straight-line Packer-Matics: the Packer Machine Company, 400 Center St., Meriden, Conn.

AUTOMATIC

PACKER-MATIC

AUTOMATIC MACHINES FOR BUFFING • POLISHING • DEBURRING • GRINDING

THE PACKER MACHINE COMPANY • MERIDEN, CONN.

SOCIETIES

A conference sponsored by the **MELBOURNE BRANCH** of the **AMERICAN ELECTROPLATERS' SOCIETY** on "Current Alternatives to Nickel Chromium Plating" was recently held at the Hotel Federal, Melbourne, Australia.

This conference was extremely successful being attended by 160 platers and representatives of the automobile, aircraft, and electrical industries, including 15 visitors from Sydney, Adelaide, Perth, Tasmania and New Zealand.

A series of papers dealing with alternative finishes was presented by well-known experts, and the meeting was then thrown open for discussion. The merits of the alternatives for nickel chromium electroplate that had been suggested, were debated thoroughly, and particular interest was shown in the new alloy electroplates.

A Federal Convention of the A.E.S. to be held in Melbourne in May, 1953, was announced. Dr. William Blum, of U.S.A., will be present as guest speaker.

MEETINGS

All exhibit space in the Federation of Paint and Varnish Production Clubs **1952 PAINT INDUSTRIES' SHOW** to be held in Chicago in November has been reserved and assigned, according to Gene Ott, chairman of the Show Committee. Demand for space greatly exceeded the capacity of the Palmer House Exhibit Hall and efforts of the committee to secure additional room in another hotel were unsuccessful.

The Show will open at 2 p.m. on Tuesday, November 18, and close at 3 p.m., Saturday, November 22. Daily exhibit hours will be from 9 a.m. to 6 p.m. The Paint Industries Show will run concurrently with the National Paint, Varnish and Lacquer Association's Annual Convention—November 17-19—and with the Annual Meeting of the Federation—November 20-22.

Committee heads for the Federation meeting have been announced by C. J. Overmyer, chairman of the meetings committee. They are: H. H. Zimmerman, host committee; Mrs. H. H. Zimmerman, ladies committee; R. R. Bruhn, registration; A. F. Bohnert, floor committee; H. G. Bogie, banquet committee; W. A. Wachholtz, entertainment committee; A. P. Stresen-Reuter, dance committee; F. Scofield, bridge tournament.

Members of the Paint Industries Show committee, in addition to Mr. Ott, are: R. C. Adams, N. P. Blackwith, T. F. Byron, H. A. McConaghie, G. H. Wescott, and C. Homer Flynn.

TRAINING COURSES

THE BINKS MANUFACTURING COMPANY, 3122 Carroll Ave., Chicago 12, Illinois, announces the following schedule for the fall, 1952, program of its spray painting school:

September 8 through 12, Monday through Friday, inclusive.

October 6 through 10, Monday through Friday, inclusive.

November 10, through 14, Monday through Friday, inclusive.

The Binks Spray Painting School is especially suitable for training officials, foremen, supervisors, distributors or jobber representatives and those who service spray painting equipment. Classes are limited in size so that each individual obtains maximum personal attention from the instructor. William Beacham, nation-

Yes: WE'D LIKE TO GET A COPY OF THE BIG NEW **M & E** SPRAY FINISHING EQUIPMENT GUIDEBOOK

SPRAY BOOTHS - Systems

M&E MANUFACTURING COMPANY
PAINT SPRAY FINISHING SYSTEMS
INDIANAPOLIS 5, INDIANA

Name_____
Title_____
Company_____
Street_____
City_____ State_____

HARSHAW *Fluoborate plating chemicals*

CADMIUM FLUOBORATE

LEAD FLUOBORATE

COPPER FLUOBORATE

TIN FLUOBORATE

ZINC FLUOBORATE

FLUOBORIC ACID

NICKEL FLUOBORATE

in CLEVELAND • 1945 E. 97th St.
in CINCINNATI • 611 American Bldg.
in CHICAGO • 505 North La Salle St.
in DETROIT • 9240 Hubbell Ave.
in HOUSTON • 6622 Supply Row
in LOS ANGELES • 3237 South Garfield Ave.
in NEW YORK • 420 Lexington Ave.
in PHILADELPHIA • Jackson and Swanson Sts.
in PITTSBURGH • 7th and Carson Sts.

HARSHAW

THE HARSHAW CHEMICAL CO.
1945 East 97th Street, Cleveland 6, Ohio
BRANCHES IN PRINCIPAL CITIES

Select the nearest Harshaw Branch

ally-known paint chemist and spray painting authority, is in charge of the classes, which are conducted at the Binks Chicago plant.

THE BROOKLYN EVENING TECHNICAL HIGH SCHOOL, 29 Fort Greene Place, Brooklyn, N. Y., will offer its free course in Electroplating for the fall term beginning September 10, 1952. The course which is limited to men in the electroplating industry will include a review of elementary chemistry, calculations for the preparation of standard solutions, specific gravity, neutralization, pH, hydrolysis, and similar related topics.

Mr. L. Serota will accept registrations the week of September 8 from 7:00 p.m. to 9:00 p.m. Classes will meet Monday and Wednesday from 6:45 p.m. to 8:15 p.m. and about six Friday evenings.

meetings

OF INTEREST TO FINISHERS

Sept. 10-12. 14th Annual Shop Practice Forum, Porcelain Enamel Institute, University of Illinois, Urbana, Illinois.

Oct. 20-24. 40th National Safety Congress and Exposition, Conrad Hilton, Congress, Morrison and Sheraton Hotels, Chicago, Illinois.

Oct. 22-24. 21st Annual Meeting, Porcelain Enamel Institute, Greenbrier Hotel, White Sulphur Springs, West Virginia.

CHEMSTEEL CONSTRUCTION COMPANY, INC.
301 Chemsteel Bldg., Walnut St., Pittsburgh 32, Pa.

Send data on Engineering & Construction facilities for
ACID-ALKALI-PROOF CONSTRUCTION
of processing & storage tanks & flooring in
☐ Steel Plant ☐ Chemical ☐ Textile ☐ Food

NAME.....
COMPANY.....
ADDRESS.....
CITY..... ZONE..... STATE.....

Nov. 17-19. 64th Annual Convention, National Paint, Varnish and Lacquer Association, Palmer House, Chicago, Ill.

Nov. 18-22. 17th Annual Paint Industries' Show, Palmer House, Chicago, Illinois.

Nov. 20-22. 30th Annual Meeting, Federation of Paint and Varnish Production Clubs, Palmer House, Chicago, Illinois.

NECROLOGY

FREDERICK HALL LANE, 69, well-known paint and varnish expert and industrial consultant, recently died in Sarasota, Florida.

A native of Brooklyn, N. Y., Mr. Lane graduated from Brooklyn Polytechnic Institute in 1904, with a B.S. degree in chemistry. He taught for a year following graduation, then joined the U. S. Navy Department as a chemist at the Brooklyn Navy Yard. He entered the paint and varnish field in 1908.

For the past 28 years, Mr. Lane served as consultant on protective coatings for Hercules Powder Company, Wilmington, Delaware. He also was a consultant for Harbor Plywood Corporation, Hoquiam, Washington, and was director of chemical research for the Florida Research Corporation.

LAMMOT DU PONT, former president of E. I. du Pont de Nemours & Company and youngest of the three brothers who led the twentieth century development of the 150-year-old chemical company, died recently. He was 71 years old.

Lammot du Pont was the eighth member of the du Pont family and the third brother in succession to become head of the chemical company founded by Eleuthere Irenee du Pont de Nemours, his great-grandfather, in 1802.

To Lammot du Pont, youngest of the trio, fell the task of rounding out and coordinating what, in little more than a decade, had become one of the most complex communities of chemical manufacturing in the Americas.

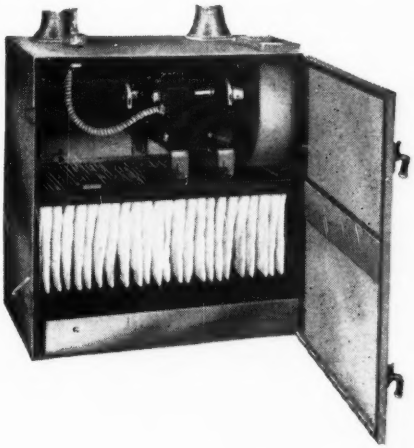
For further information on any product mentioned in this issue—use the READER SERVICE CARDS between the covers.

HUSKY and FAST!

Long trouble-free service and ease of operation are the prime requisites for equipment of any kind.

HISEY Buffers - Polishers embody these features to such extent that they afford lowest cost per year with maximum production.

They are made from small bench types up to 30 H.P. Pedestal types. There is a size and type particularly suited to your requirements. Let us show you.



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These new HISEY Dust Collectors fill a long felt need for efficient dust collecting at reasonable cost. They are made in four sizes which cover most applications and can be supplied with new machines or for machines already in service.

•

CATALOG 72-PA FREE ON REQUEST

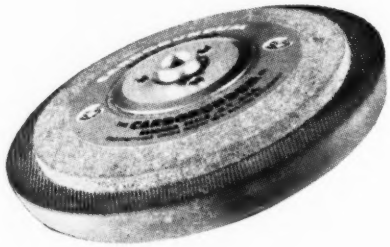
Hisey THE HISEY-WOLF MACHINE CO.
CINCINNATI 8, OHIO
Division of The Cincinnati Electrical Tool Co.

Leading the COATED ABRASIVES PARADE —as usual

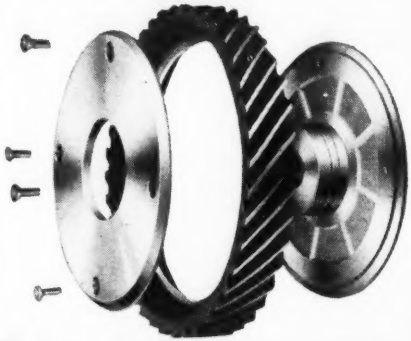
A CONDENSED REPORT TO THE METAL-WORKING INDUSTRY

on CARBORUNDUM's continuing leadership: major developments of the most recent 12-month period.

● RED-I-CUT WATERPROOF PAPER introduced a year ago, has revolutionized wet-sanding practices of thousands of operators. A completely new type of flexible backing is combined with tough abrasive grain—and a new resin bond to produce a faster cut, a better finish, and up to 50% longer useful life on production runs.



weld cleanup, edge-breaking, contour finishing. On many jobs it eliminates 2 or 3 separate abrasive operations.



● "61" SERRATED RUBBER CONTACT WHEEL principle has brought an entirely new concept to abrasive belt versatility and performance. *Controlled breakdown* of the bond is the outstanding accomplishment...virtually eliminating glazing and loading—in most cases actually *doubling the productive life* of each belt. "T-61" Universal Hub Contact Wheel —a further improvement—has cut your contact wheel costs virtually in half. When the serrated rubber "tire" wears out, throw it away and replace with new tire at half the cost of standard type wheel. Original cost of complete 3-part assembly is no higher than the previous solid wheel—in some sizes, lower!

YOUR CARBORUNDUM DISTRIBUTOR

is now more than ever fully equipped to serve you—thanks to this continuous development of product and process. Call him today—you'll find him listed under "Abrasives" in the yellow pages.

● FASTCUT Pad has enabled abrasive cloth discs to achieve finer finishes on metal than ever before. Through the resiliency of this soft rubber back-up medium, swirl patterns and harsh scratches are eliminated.

● "PORT-A-BELT" GRINDING ATTACHMENT is the world's first—a brand-new abrasive idea that lets you bring the belt to the work. Ideal work-speeder and money-saver on die and mold grinding,

● QUALITY CONTROL with BETA-RAY GAUGES first ever installed by any abrasives manufacturer, means assured, positive uniformity of coated abrasive from lot to lot, from year to year. This process permits control and standardization of backing, of adhesive coat, of grain coat, of sizing, to precise and predictable tolerances.

Look to CARBORUNDUM

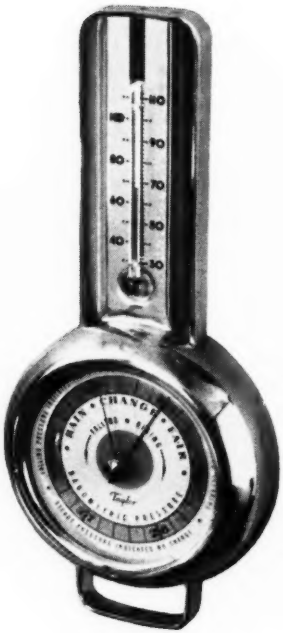
TRADE MARK

for the NEW developments in ALL abrasive methods

"Carborundum", "Red-I-Cut", "Port-A-Belt" and "Fastcut" are trademarks of The Carborundum Company, Niagara Falls, New York

9?-78

Finishes



This beautiful York Pendant Baroguide is processed in three parts: the upper and lower frame, and the bezel assembly. The brass surfaces, after having all imperfections removed, are cut down, buffed, and colored using carefully selected buffs and compounds.

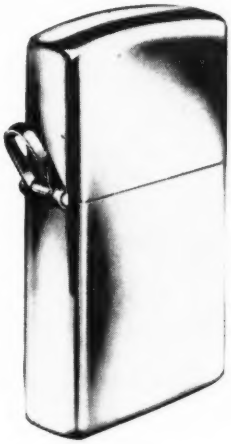
(Photo courtesy Taylor Instrument Companies, Rochester 1, New York)

This aluminum rice mold, product of Daito Kinzoku Kogyo Company, Tokyo, is typical of Japanese kitchen utensils. The finish on the rice mold is produced as follows: (1) chemical polish in phosphoric-sulfuric-nitric acid mixture; (2) anodize in sulfuric acid; (3) dye to a golden color in a hot concentrated tea solution; (4) dip in 3 per cent potassium dichromate; (5) seal in steam at 60 p.s.i.; (6) color buff lightly.

(Products Finishing Staff Photo)

The arc welder features silicone insulation, low open circuit voltage and an automatic hot start. Cases, tops and bottoms are spray lacquered, the combination name plate and calibrated output panel is painted by the silk screen process, and the control handle is chromium plated.

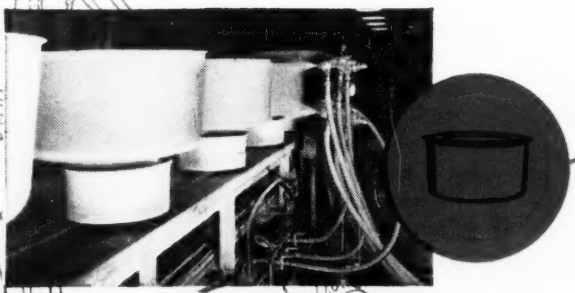
(Photo courtesy Metal & Thermit Corporation, New York 17, New York)



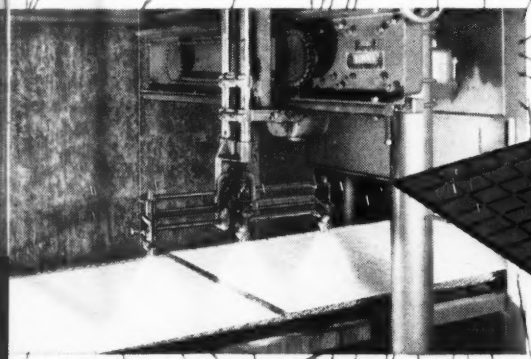
The Zippo Tack-A-Loop has a handy loop attachment, fastened to the hinge of the lighter cover, to keep the lighter where it is supposed to be. This wind-proof model is chromium plated and brush finished.

(Photo courtesy Zippo Manufacturing Co., Bradford, Pa.)

How to cut finishing



Automatic finishing eliminates slow, costly manual spraying operations in volume production.



costs automatically...

...if it's round

Binks automatic spindle machines finish round, cylindrical, many-sided or hollow products...inside and/or outside. The product spins in front of Binks Model 21 spray guns. Guns shut off automatically if an empty spindle passes, thus saving painting or coating material. Top illustration at left shows Binks Model 21 spray guns coating exterior of washing machine tubs. Here, automatic finishing not only improved finish quality...it also saved enough material to pay for the automatic equipment *in just 1 week!*

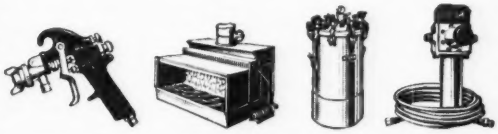
...if it's flat

Binks automatic reciprocating machine finishes such flat surfaces as wallboard, linoleum, plywood, tile, glass, table tops, range parts, refrigerator parts, shingles, outdoor signs and many other products. Mechanical arms sweep Binks Model 7R spray guns back and forth across the conveyor. Lower illustration shows Model 7R guns applying synthetic enamel to wallboard.

CALL IN A BINKS ENGINEER...

If your finishing or coating even faintly resembles a mass-production operation. He'll tell you if automatic finishing is feasible, and, if so, how it would cut costs and give you better finishes to boot. If necessary he'll arrange a private test at Binks on your products using your materials and will bring you a confidential report without charge or obligtion. To reach a Binks engineer call your nearest Binks office or contact us at:
Binks Manufacturing Company,
3118-40 Carroll Ave., Chicago 12, Illinois.

Binks
EVERYTHING FOR SPRAY PAINTING



GUNS • SPRAY BOOTHS • MATERIAL TANKS • EXTRACTORS & ACCESSORIES

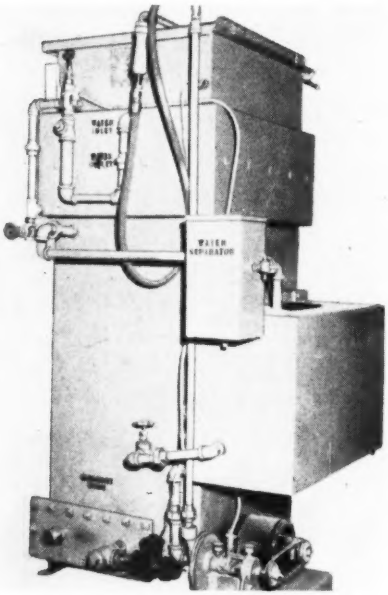
REPRESENTATIVES IN PRINCIPAL U. S. & CANADIAN CITIES • SEE YOUR CLASSIFIED DIRECTORY

New • EQUIPMENT • MATERIALS • PROCESSES

Ramco Vapor Degreaser

Vapor Degreaser Model GU24, applicable for straight vapor or vapor-spray degreasing, has been announced by the Randall Manufacturing Company, Inc., 801 Edgewater Road, New York 59, New York.

The degreaser is fabricated of stainless steel and heated by steam. Accessories include a vapor level safety thermostat, a water economizer, and a heavy duty spray pump. It is available in twelve standard models, but can also be designed and built for special applications. All units are built in a manner allowing them to be conveyorized.

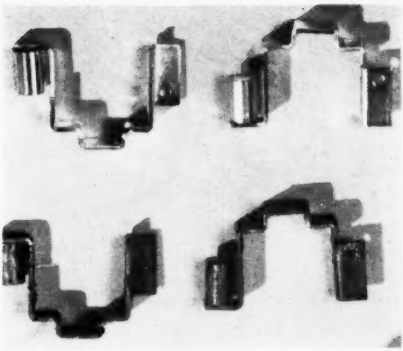


Ramco Vapor Degreaser

Roto-Finish Compounds

Several additions to the Roto-Finish line of compounds used in the Roto-Finish process for finishing a wide variety of metal parts have been announced by Mr. C. H. Castle, Vice President and Technical Director of the Roto-Finish Company, 3700 Milham Road, Kalamazoo, Michigan, P. O. Box 988.

In general, Roto-Finish Compounds furnish lubrication for processing media, parts being finished, and maintain cleanliness of processing media and compartments. Other important characteristics are stated to be prevention of tarnishing, etching or rusting of parts being processed. Some of these compounds are: No. 10-S for general use where a fine matte surface is desired; No. 11, for deburring ferrous parts; No. 13 for rough deburring or cutting down operations; No. 14-M, for grinding and severe cutting; No. 100 for deburring and polishing; No. 101 for deburring and finishing aluminum; No. 202, for Britehoning all types of metals; No. 255, for bright polishing operations, and No. 300 and 355 coloring compounds.



Alkaline Tin Lead Stripper

Alkaline Tin Lead Stripper

An alkaline chemical for rapid dissolving of tin, lead and tin-lead alloys has been announced by Enthone, Inc., Dept. PF, 442 Elm Street, New Haven, Connecticut. This material is used in water in a concentration of 1 lb./gal., and the mixture is heated to from 160 to 180 degrees F. The stripper is stated to rapidly remove tin, lead and tin-lead electrodeposits, heavy solder and hot dipped coatings. The material is kept in steel or stainless steel containers and does not deteriorate with age.

The stripping action on both tin and lead is fast and thicknesses of the order of 0.005 in.-0.010 in. are removed in one hour, the manufacturer states. The product is suitable for removing of solder from torch or iron soldered pieces as well as hot dipped soldered articles, and unlike acids does not cause any dimensional change in the base metal.

Faxfilm Surface Comparator

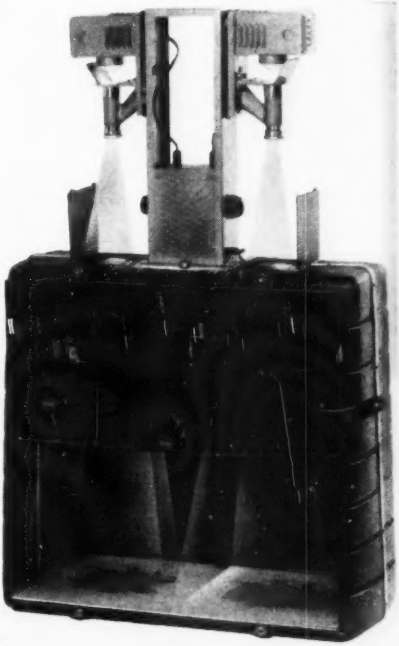
Greater flexibility in use, increased portability and more pleasing appearance are stated to be the features of the Faxfilm Surface Comparator, Model BL-122, now being introduced by The Brush Development Company, Instrument Division, 48 G, 3405 Perkins Avenue, Cleveland 14, Ohio. Faxfilm is a method of surface study in which a clear plastic replica of a surface is projected in a microprojector to show minute details of surface condition.

The comparator provides comparison projection of two Faxfilm replicas at 30 diameter magnification. Its principal uses include comparison of work specimens with standard finishes in surface roughness inspection, and comparisons of surface changes in wear and life tests.

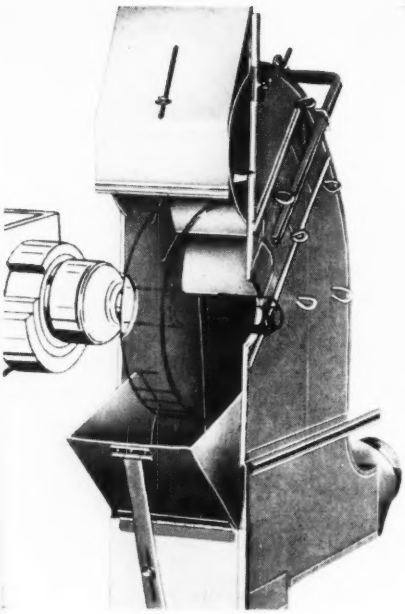
The BL-122 Surface Comparator is 25 inches by 12 inches at the base and 22½ inches high and total weight is less than thirty pounds. The specially designed Faxfilm Micro-Projectors use Wollensak 1-inch f:1.9 projection lenses.

Air-Flow Exhaust Hood

An exhaust hood which uses the natural draft created by high speed motion of



Faxfilm Surface Comparator



Creative Air-Flow Exhaust Hood

buffing wheels and belts to carry away used polishing compound and metal particles has been announced by Creative Development & Mfg., Inc., 369 Springfield St., Dayton, Ohio.

Advantages, according to the manufacturer, are cleaner, more healthful working conditions, greater safety, lower maintenance cost for polishing room equipment, and less airflow in main exhaust system.

The Creative Air-Flow hood is adjustable for wheels from 10 through 16 inches in diameter and up to 7 inches in width. A dust scoop bin is provided at the bottom of the hood so that heavy particles can be removed. Both base and hood are fabricated of heavy gauge steel, spot welded throughout.

Fisher Electro-Analyzer

Unattainable flexibility, speed and convenience are stated to be some of the characteristics of the Fisher Electro-Analyzer available from the Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

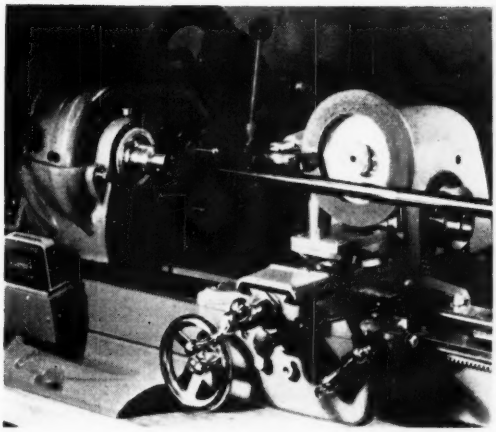
Available in two-spindle models, this analyzer allows the laboratory technician to make separate or duplicate analysis at the same time. Increased power facilities up to 10 volts at 10 amperes and close temperature control are some of the added features of the instrument. A stirring motor is located at each sample station.

Various accessories available for this analyzer are basket or spiral type electrodes or stirring electrodes and a Mercury Cathode Cell Kit. This kit is claimed to do away with time consuming pre-analysis separations, by simply plating out on the mercury any undesirable elements and then withdrawing the mercury.

Abrasion Tester for Cylindrical Parts

Taber Instrument Corporation, 115 Goundry Street, North Tonawonda, New York, has announced an abrasion testing machine for rating the wear resistance of protective finishes, such as black oxidized

Fisher Electro-Analyzer



Model No. W-3981 Cylinder Abrasion Tester

or electroplated coatings, on ordnance and metal furniture tubing and other cylindrical parts or test pieces.

Tests are performed by placing the tube, or gun barrel as illustrated, between two driving centers with the test surface in contact with the abrading head. This abrading head can be adjusted lengthwise of the barrel to any position within its range. Pressure of the abradant against the test surface is applied by a floating dead weight load system, which compensates for minor inaccuracies of the test part.

The tester is fully adjustable to take cylindrical specimens from ½ to 6 inches in diameter and 8 to 36 inches in length. The abarsion resistance is reported as the "number of wear cycles" the surface will withstand before penetration of the protective finish permits corrosion to take place. The wear cycles are indicated by an electric counter at the left of the operator. One wear cycle is one complete revolution of the abradant wheel.

Kelite Detergent PWB 81

Rapid cleaning of aluminum, anodized aluminum and magnesium parts in powder washing equipment is made possible with the development of a detergent by Kelite Products, Inc., 1250 North Main Street, Los Angeles 12, California.

Known as Kelite PWB No. 81, the detergent is a powder which is readily soluble in water. The manufacturer states that complete removal of virtually all types of soil, including Reynolds, Alcoa and Kaiser ink markings in approximately one minute is afforded. Other qualities of the new detergent are: it is non-foaming, non-corrosive, has extreme stability and long-life.

Pocket Tumblers

Tumb-L-Matic, Inc., 4510 Bullard Avenue, New York 70, N. Y., has announced a tumbling barrel having individual "pockets" for tumbling from 2 to 6 items at a time. The "Pocket Tumbler" is recommended for deburring, precision finishing and polishing small metal parts such as jewelry findings, ornaments, stampings, screw-machine parts and gears.

The Pocket Tumbler comprises a rotating container, or frame, into which the

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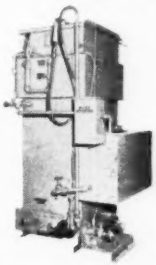

VAPOR — SPRAY — VAPOR
Model GU24 steam heated. Fabricated of stainless steel. Accessories: vapor level safety thermostat, water economizer, heavy duty spray pump.

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801 EDGEWATER RD., NEW YORK 59, N. Y.
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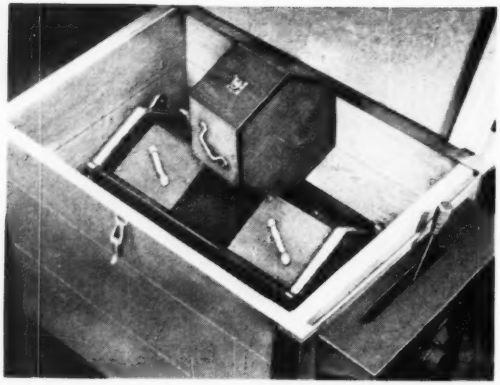

pockets fit and which is enclosed on five sides during tumbling to hold the pockets in. One side of the frame opens to permit pockets to be inserted and removed. By having an extra supply of pockets, loading and unloading can be accomplished while other pockets are being tumbled.

Tumblers are available with frames for handling from 2 to 6 pockets; pockets range from 12 to 16 inches in diameter. Two models, the submerged type for wet tumbling and the self-contained type which can be adapted for either wet or dry operation are available.

Curran Metal Dry Degreaser

The Curran Ordnance Chemical Laboratory, Prospect Mills, Lawrence, Massachusetts, has developed a high-performance metal degreaser designated FLO. Technically a flowlene degreasing solvent, it is a clean-drying safety product for rapid solvent dry degreasing of parts and engine accessories and is especially adapted for cleaning electrical accessories, the manufacturer states.

The solvent is said to be relatively odorless, easy to handle, and safe for use in all types of equipment designed for liquid phase solvents. It is claimed to be noncorrosive, quick drying and harmless to all makes and types of liquid phase solvent recirculation machines.

Current Density Meter

Accurate determination of plating deposit at all points on any article, before plating, is made simple, quick and easy by a current density meter announced by Belke Manufacturing Co., 947 N. Cicero Ave., Chicago 51, Illinois.

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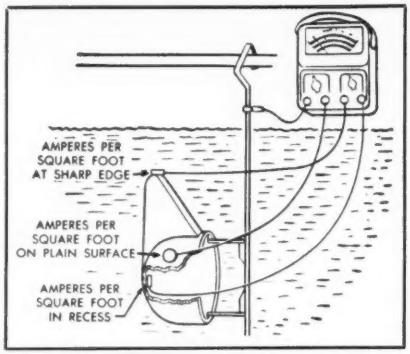


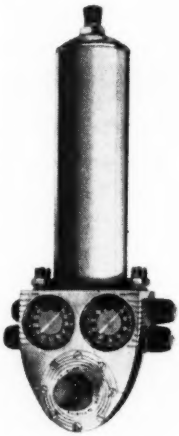
Current Density Meter

Known as the Belke-Kotz Current Density Meter, this instrument has three test leads which can be attached to the surface of the article at three selected places. By turning a dial switch on the meter, amperes per square foot can be read at each of the test points. Comparing the readings with a current density chart for the solution shows whether plating rate is too high or too low.

To determine proper racking and location of the article in the tank, current density may be read instantly at each of the three points with the article in any position. The best plating voltage for the specific requirements of the article is readily determined. Also, the meter instantly indicates variations in throwing power of the solution. Nine scales with ranges from 0-3 to 0-3000 amperes per square foot afford reading in any range.

HLD Air Transformer

The DeVilbiss Company, 300 Phillips Avenue, Toledo 1, Ohio, has introduced the HLD Air Transformer, described as being more efficient, easier operating, sturdier constructed and having a greater capacity.



HLD Air Transformer.

The transformer has a built-in two stage regulating principle which provides for easier adjustment of pressures, requiring only finger tip control of the adjusting knob, it is stated. The knob actuates a small pilot regulator which in turn operates the diaphragm of the large regulator, thus giving ease of operation. The two-stage regulator also provides for closeness of pressure loss.

Oil and moisture, present in all compressed air lines, is eliminated by the HLD transformer which traps the liquids and delivers clean air to all outlets. In tests, 97 per cent of entrained water was removed from air at 100 pounds pressure.

Surface Finishing Machine

A modification of the Clair Model 203 Surface Finishing Machine has been in-

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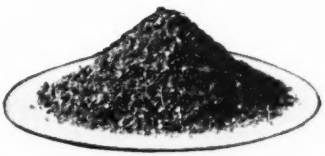

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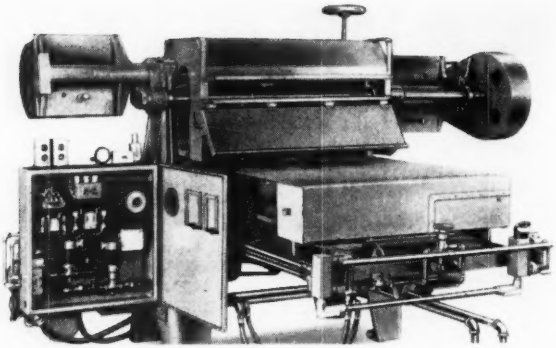
Surface Finishing Machine



troduced by The Clair Manufacturing Company, 1010 South Union St., Olean, New York. Designated the Model 203-A, this machine was developed specifically for surface finishing formed decorative name plates for refrigerators, stoves, appliances and so forth.

Through a vacuum chuck arrangement, the Model 203-A will handle name plates made of brass, copper, silver, plastic, aluminum, wood and other non-magnetic materials. The manufacturer stresses that even small items can be held and surface finished without interference with coverage over the entire surface. An improved feature of this modified unit is the fact that all controls have been assembled at a central control panel.

Buffs used on this machine ordinarily are 9 inches in diameter, but can be increased to 12 inches if desired. The work table consists of a perforated plate mounted over a sealed air space, this space being connected to a vacuum pump through a 4-way spring valve.

Metallizing Coatings

Doram Products, Inc., of 410 Frelinghuysen Avenue, Newark 5, New Jersey, coating specialists to the metallizing field, has now available the following line of materials to the trade.

Doramet 34, which is a metal coating, especially suitable for steel. It is thermosetting, tough, durable, flexible and posesses exceptional adhesive qualities it is stated. Its high solid content insures good gloss and reflectivity.

Polystyrene has been metallized successfully using the following combination of coatings: KS75 as a base coat with KS751 as a top coat. This combination of coatings will not attack the polystyrene and imparts a gloss to the product. The manufacturer states that adhesion is good, water resistance excellent, and because of the thermosetting qualities of the coating, subsequent tackiness in hot humid weather is not encountered.

Roto-Finish Separator

The Roto-Finish Co., 3700 Milham Road, P. O. Box 988, Kalamazoo, Michigan, has developed a combination mechanical magnetic separator especially designed to separate parts from abrasive chips where both ferrous and non-ferrous parts are processed.

The unique feature of the model No. MMG 34-12 is that the magnetic and mechanical separating mechanisms are interchangeable on the portable frames. As a result, it can be used either as a mechanical or magnetic separator and is recommended for use in conjunction with the original processes, used to grind, deburr, descale, britehone and color all types of metal parts.

When used for mechanical separations the mixed parts and processing media pass over a motor driven agitated separator screen. Separation is made as the oversize parts are discharged from the top of the screen, while processing chips

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Here is data on tanks, temperatures, cleaners—and the facts about BLACK MAGIC Type A BLACKENING SALTS.

This new BLACK OXIDE finish easily blackens heat-treated pieces, uses less salt, operates at a lower temperature, requires no rectification by cyanide additions, requires only one tank, one salt.

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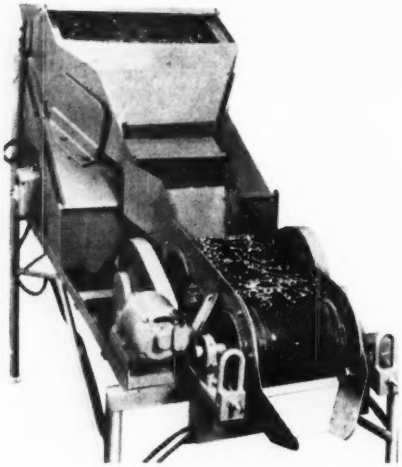

Roto-Finish Separator

go through the screen into a hoist pan below.

For magnetic separations the magnetic separating unit replaces the agitating screen unit. Parts and chips pass over a magnetic pulley and parts are separated magnetically and then conveyed to a container, while the chips fall into a hoist pan below.

Screens are available in mesh sizes of $\frac{1}{16}$ inch to $1\frac{1}{2}$ inch and correspond to chip sizes. Screen size is 34 inches by 27 inches.

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Speed Industrial Drying, Baking and Heating

Engineered for production use, Nalco Infra-Red Lamps with long-lasting carbon filaments give less glare, more penetrating heat . . . assure completed jobs at a faster rate—and at a much lower cost.
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NALCO INFRA-RED DRITHERM

NORTH AMERICAN *Electric Lamp Co.*

1020 TYLER ST. ST. LOUIS 6, MO.

Giant Fulljet Spray Nozzles

A group of FullJet Spray Nozzles has been developed by the Spraying Systems Co., 3201 Randolph St., Bellwood, Ill., to meet the requirements of a variety of heavy duty industrial applications. Largest of the nozzles has an orifice diameter of $5\frac{5}{8}$ inches, is 21 inches high, and provides passage without clogging for impurities as large as $2\frac{5}{8}$ inches in diameter. Capacity of this nozzle is 1,550 g.p.m. at 10 p.s.i.

Spraying Systems Giant Nozzle

FullJet nozzles of this type are supplied with flange mounting or with female pipe connection, in a range of more than 30 sizes. This line is an extension of the standard but smaller FullJet nozzle group.

Camaco Electric-Air Hot Spray Unit

A hot spray unit which controls the temperature of the paint at the spray gun instead of in paint heaters has been developed by The Capitol Machine Company, 36 Balmforth Ave., Danbury, Conn. This system converts any moisture, oil, or water in air supply to a vapor which blends with the air creating a perfectly neutral atomizing air supply at all times, the manufacturer states.

The unit is available in models with

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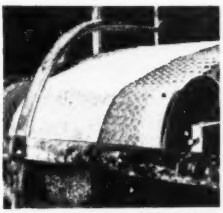

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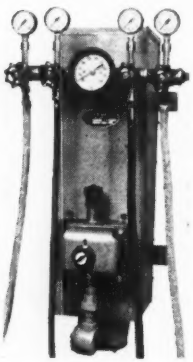
four and six gun outlets and can be used with any spraying equipment. Air temperature is regulated by a specially designed control and heating circuit. Air pressure is individually controlled for each gun and no hot air passes through the pressure regulator, according to the manufacturer. The unit, which is added between the regulator and the spray gun, is portable but can be mounted on the spray booth.



Camaco Electric-Air Hot Spray Unit

Advantages of the unit claimed by the manufacturer include low operating cost, avoidance of any moisture getting on work, the elimination of cleaning heaters, tanks and other apparatus, and ease of switching colors.

PRODUCT LITERATURE

For further information on any product mentioned in this issue—use the READER SERVICE CARDS between the covers.

Adhesion of Hard Nickel To High Strength Aluminum Alloy. This booklet, available from Dept. EZ, International Nickel Co., 67 Wall St., New York 5, N. Y., describes improved procedure of the zincate process for electroplating on aluminum alloys. Ten tables and working drawings aid in explaining the method which uses a mixed acid pickle and cathodic zincate treatment and is applicable on other aluminum alloys which are difficult to electroplate with adherent deposits. A modification of the Ollard test for measurement of the adhesion of deposits on sheet specimens is described.

Holland Finishing Equipment. J. Holland & Sons, 276 S. 9th Street, Brooklyn 11, New York, has published its 1952 catalog, illustrating and describing its complete line of finishing equipment. Included in this catalog are data, illustrations, and valuable information on the finishing equipment field.

Gardner Testing Devices. A leaflet, **No. 111,** describes and illustrates various testing devices available from Henry A. Gardner Laboratories, Inc., 4723 Elm St., Bethesda 14, Md. Included are stands for the Gardner Thickness Gage and the Ford Viscosity Cup, liquid container for Gardner Washability Machine, immersion pump, and others.

"Nomenclature," a glossary of terms for aluminum sheet and plate and extruded and tubular parts, is available from The Aluminum Association, 420 Lexington Ave., New York 17, N. Y. Designed to promote better understanding between producer and consumer, the booklet contains definitions of sheet and plate products and of extruded and tubular products and defines miscellaneous terms applicable to each.

Standard Electric Spray Booth Fan. A data sheet which lists sizes, speeds, and prices of spray booth fans is available from Standard Electric Mfg. Co., West Berlin, N. J. The various models are built, according to the manufacturer, to underwriters specifications for general application in areas requiring positive elimination of hazardous fumes and vapors.

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TACK "Magic" RAGS
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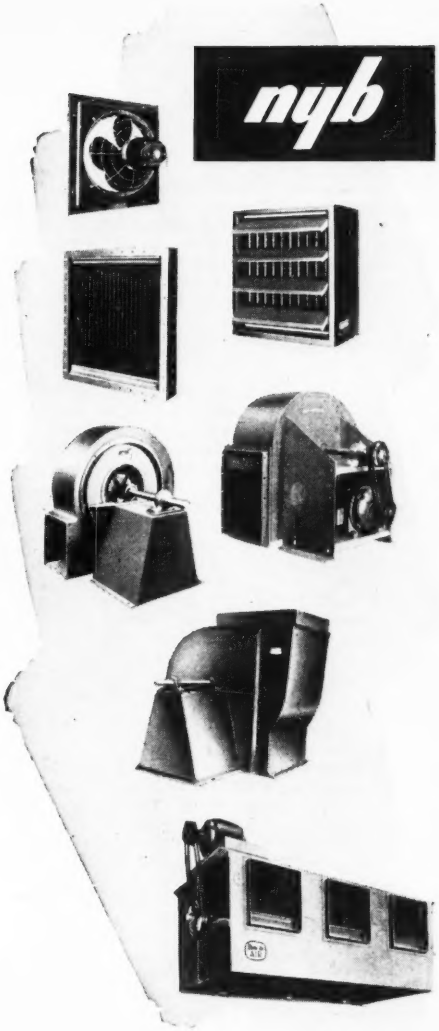

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For Continuous Heat Service up to 150 Pounds Steam Pressure

The rugged arc welded construction outperforms and outlasts heating elements made of thinner non-ferrous metals, avoids their expansion-contraction faults, yet has the same BTU efficiency.

Originated in 1922, it has an enviable record of dependable performance.

Write for copy of Bulletin 514, also 492 which gives engineering details

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FACTORY, LAPORTE, INDIANA

Carlyle Hose Assemblies. An eight-page colored catalog which completely describes hose assemblies for all types of finishing equipment is available from Carlyle Rubber Co., Dept. Z-3, 65 Park Place, New York 7, New York.

This illustrated catalog lists prices and specifications for hydraulic fluids, paint and solvent spray, lubrication, and general purpose assemblies. Various coupling combinations and the application of hose and couplings are illustrated.

Kocour Analytical Sets. Control sets for cadmium and zinc electroplating solutions are described in a leaflet prepared by Kocour Co., 4800 S. St. Louis Ave., Chicago 32, Ill. The equipment and wall cabinet into which the sets fit are illustrated.

M C Coatings, Finishes, and Adhesives. A six-page catalog is available from Merchants Chemical Co., 55 Day St., South Norwalk, Conn., describing its standard products. Included are descriptions of a corrosion resistant coating, a plastic strippable protective film, an abrasive safety coating for treading surfaces, an acid resistant maintenance coating, and others.

Attractively illustrated in color, the catalog points out outstanding properties and various applications of the products.

Schaffner Grip-Grain. A folder which describes Schaffner Grip-Grain, a cold cement for polishing wheels and abrasive belts, is available from Schaffner Manufacturing company, Inc., Emsworth, Pittsburgh 2, Pa. Steps in application of this cement, as well as its characteristics are outlined.

Hercules SS Nitrocellulose. A revised edition of the technical booklet about SS Nitrocellulose, a specialty nitrocellulose, is now available from Hercules Powder Company, Delaware Trust Building, Wilmington 99, Delaware.

To aid the formulator this revision includes 20 charts which illustrate studies in solubility of SS Nitrocellulose. The charts are divided into four groups, by the use of color, to show the effect of viscosity of the material; the effect of ethanol, the effect of diluent; and the effect of type of alcohol used. Also included is information about the use of SS Nitrocellulose in heat-seal lacquers; aniline inks; and as a shellac modifier.

Continuous Wide Chart Recording of Alternating Voltage or Current. Instrumentation Data Sheet No. 9.1-13, available from Station 40, Minneapolis-Honeywell Regulator Company, Wayne & Windrim Aves., Philadelphia 44, Pa., describes the use, operation, and advantages of continuous wide chart recording of alternating current through the use of an ElectroniK strip chart recording potentiometer together with a Weston thermal converter. The data sheet includes illustrations and dimensional drawings of all units.

Detrex Rust-Proofing Process. The Detrex phosphate coating process 501 which protects iron and steel from corrosion is explained in a booklet available from Detrex Corp., Box 501, Detroit 32, Mich. The booklet illustrates the process with precleaning by alkaline compound, by sol-

Modern Masking Materials and Methods for Fabrication and Spray Finishing

By Arthur P. Schulze

64 Pages *47 Illustrations*

Written for department superintendents, shop foremen, process and finishing engineers . . . this manual is a source of ideas for saving time, cutting costs and getting better product quality.

Price $1.00

PRODUCTS FINISHING

710 Schmidt Bldg., Cincinnati 2, Ohio

vent degreasing, and by alkaline compound and pickle. Detrex paint bonding compounds are also discussed.

Buffing, Polishing, and Grinding Equipment. Murray-Way Corporation, Box 180, Birmingham, Mich., has issued a brochure which shows a representative group of its standard and special-built equipment for automatic polishing, buffing, and grinding. Included is descriptive material about the 51 and 52 multi-position polishing heads, the 60 series polishing head, the micro polish unit in single and multiple installation, and other Murray-Way developments.

Gasway Rollacoat Finishes. This 12 page, well illustrate booklet, available from Gasway Corporation, 6463 N. Ravenswood Ave., Chicago 26, Ill., discusses the principle and mechanics of roller coating. One and two strip coating are explained and illustrated and factors in the selection of coating rolls are discussed.

Lead Anodes. Bulletin No. 92 issued by the Heil Process Equipment Corp., 12901 Elmwood Ave., Cleveland 11, Ohio, describes sawtooth, herringbone, flat, and other types of lead anodes for plating. One page of the four-page bulletin is devoted to hook specifications and hook description.

Rameo Vapor Degreaser. How vapor degreasing can be adapted to a wide variety of industrial cleaning problems and the types of equipment that are best suited to given degreasing needs are given comprehensive definition in an 8-page, well illustrated, brochure, just released by Randall Mfg. Co., Inc., 801 Edgewater Road, New York 59, New York.

Any manufacturer who is concerned with oil and grease covered work will find many helpful suggestions in this literature. Included are applications affecting small parts that must be handled in mass, or where soil adheres stubbornly.

On any steel blackening problem

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Here's an example . . .

Du-Lite gave this part with its complicated knurls, slots, threads, etc. a fine rust-resistant durable black finish. It is typical of many other parts, small and large, which have been black oxidized by Du-Lite for many years. Moreover, Du-Lite meets most individual and government specifications including 57-0-2C for Type III Black Oxide finish.

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METAL FINISHING SPECIALISTS

For more complete information on products and processes use READER SERVICE CARDS inside covers.

"Vacuum Metallizing Today," is the title of an attractive 12-page brochure published recently by the F. J. Stokes Machine Co., 5500 Tabor Rd., Philadelphia 20, Pa. It describes and illustrates the basic principles of vacuum metallizing and explains how it can be applied to the surfaces of plastics, metals, glass, paper, textiles, leathers, and many other products. The process, including pre-treatment, drawing of vacuum, metallizing, and finishing, is described in detail in the colorful booklet, and comparative costs are shown. Stokes vacuum metallizing units also are pictured, accompanied by specifications and mechanical descriptions of their design and construction.

Lea Gun Movers. A one-page data sheet illustrates and explains the Lea Gun Mover, a compressed air-operated device for the application of liquid compositions, such as Lea Liquabrade surface finishing compounds to wide faced buffs. The information is available from Lea Manufacturing Co., 16 Cherry Ave., Waterbury 20, Connecticut.

Mechanical Properties of Nickel Deposits. A 12-page booklet which describes the wide range of properties that may be obtained in electrodeposited nickel by varying the solution and plating procedure is available from Dept. EZ, International Nickel Co., Inc., 67 Wall St., New York 5, N. Y. The booklet, illustrated with 13 charts, 3 tables, and numerous photo-micrographs, includes data on the interrelation of ductility, strength and hardness in deposits that may be obtained in present-day rapid nickel plating solutions.

Cambridge Industrial Wire Cloth. Applicatons for wire cloth in bulk or in specially fabricated parts are discussed in a four-page, colored, well illustrated bulletin, **(No. 106)**, available from The Cambridge Wire Cloth Co., Cambridge, Md. Some of the fabricated parts and examples of the weaves available in bulk wire cloth are illustrated.

Brightboy Rubber Cushioned Abrasives. An introductory sample card which contains three hand tablet samples of rubber cushioned abrasives is available from Weldon Roberts Rubber Co., 6th Ave. and N. 13th St., Newark 7, N. J. Textures offered are Fine-Tex for working soft metals and producing special finishes; standard for burring, finishing, cleaning, and polishing, and Tuff-Tex for removing tool and weld marks and to aid in producing finishes on hard metals.

"Your Oven Problem," is the title of a colorful, 4-page folder available from Michigan Oven Co., 4544 Grand River Ave., Detroit, Mich. Illustrated and described are the Michigan Cabinet type oven, developed for low volume production and for laboratory use, and the large kiln type oven.

AHCO Finishing Compounds. The Apothecaries Hall Company, Waterbury 88, Conn., has issued a series of six bulletins describing the latest developments from AHCO's finishing laboratories. These finishing compounds include Stainless Steel Buffing Compound (Bulletin B-1), Greasless Compound (Bulletin B-2), Liquid Buffing Compound (Bulletin B-3), Burnishing Compound (Bulletin B-4), Cutting Compound (Bulletin B-5), and Water Displacing Liquid (Bulletin B-6).

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Engineering Economics. In a well illustrated, 16-page booklet the Battelle Memorial Institute, 505 King Avenue, Columbus 1, Ohio, explains its activities in coordinating technology and economics, under the name Engineering Economics. Some of the Battelle services, such as industrial market research, raw materials studies, diversification studies, research planning, operations research, technological assistance, and others, are discussed. Also, several pages are devoted to case histories which show Engineering Economics in practice.

Buffalo Industrial Exhausters. A colorful 32-page catalog, **Bulletin No. 3576-B** is available from Buffalo Forge Company, 190 Mortimer Street, Buffalo 5, N. Y. Showing Buffalo's complete line of industrial exhausters, the booklet contains capacity rating tables for all sizes from 25 to 80 with wheel diameters from 17½ inches to 80 inches. Also included is information on minimum pipe sizes and hoods for tank exhaust systems, arrangements available and engineering charts for air-flow friction and so forth.

Dravo Counterflo Heaters. A revised edition of a 12-page bulletin describing Dravo Counterflo Heaters is available from Dravo Corporation, Heating Department, Fifth and Liberty Aves., Pittsburgh 22, Pa. Principal addition to the bulletin, **No. 523-B,** is information concerning use of the heater in various applications, such as process drying, medium temperature drying, tempering make-up air, and drying vehicles after washing.

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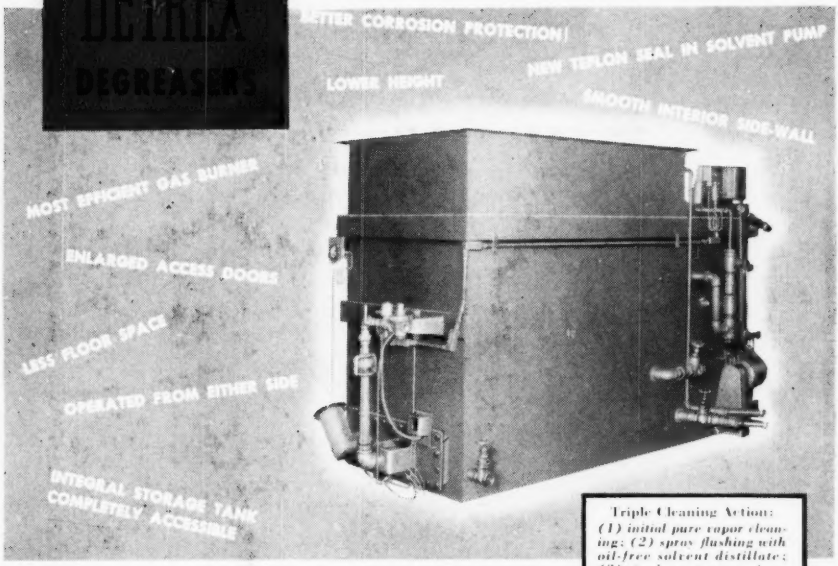

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